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TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK. 325
Well Drilling Plant at the Columbian Exposition.... 326
An Abnormal Valve Gear (*illustrated*).............. 326
The Testing and Use of Portland Cement in Europe. 327
Ore Car, Duluth & Iron Range R. R. (*illustrated*).... 328
The Lidgerwood Transfer for Coaling Sheds (*illustrated*)........ 328
Direct Driven Generators.................. 329
The Construction of Reservoir Embankments....... 330
Heating and Lighting Street Railway Cars.......... 338
Engines for Electric Railway Power Houses......... 338
The Trans-Siberian Railway............... 340
Notes from Recent Water Works Reports......... 340
Weather Report for September.............. 341

PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS.......... 331, 333

EDITORIAL NOTES.......... 334
Difficulties in Working Harvey Armor Plates—The Battle Creek Collision and Its Lessons—Air Brakes in the Jackson Collision—The Vanderbilts' Purchase of the Lackawanna.

EDITORIAL.......... 335
The Soaring Power of Birds.

LETTERS TO THE EDITOR.......... 336, 337
Concerning Montreal Floor Construction—The Canadian Society of Civil Engineers' Report on "Professional Status"—Errata in Henck's and Other Field Books—Effect of Rate of Increase of Load in Cement Testing—The Mechanics of Flight, "Potential Lift"—Triangulation on River Surveys—English and American Railways.

CONSTRUCTION NEWS..........342, 344
Railways, Street Railways, Elevated and Cable Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Contract Prices, Miscellaneous Contracts and Supplies.

INDUSTRIAL NOTES.......... 344

The competition for plans for new water-works to be built by the city of Evansville, Ind., noted in our issue of Aug. 3, resulted in the submission of plans and estimates from 17 different persons, the estimated cost ranging from $184,000 to $983,000. The plans have not been passed upon, so the names of the competitors are not yet known. It is said that a majority of the plans recommend filtration and pumping to stand-pipe. Prizes of $1,000, $500 and $250 have been offered for the three best plans, the engineer submitting the best plans to be employed as consulting engineer, providing his terms are satisfactory.

The Indianapolis Water-Works Co. has secured from a United States court a permanent injunction against the discharge into the White River of wastes from the works of the American Strawboard Co., of Noblesville, said to be 22 miles from Indianapolis. The mill was erected in 1891, and it is alleged that it uses 3,000,000 gallons of water per day, all of which is discharged into the river, carrying wastes from 80 tons of straw, 29 tons of lime and 5 tons of muriatic acid, used each day in the mill. The total amount of refuse discharged into the river is given as 67 tons per day. It is stated that the river is thus so polluted as to become discolored, offensive to the smell and taste, unwholesome for domestic purposes, and destructive of fish. It is claimed that the pollution has been so pronounced at Brood Ripple, nine miles above Indianapolis, where a dam diverts water to a canal from which the water company cuts ice, as to render the ice unfit for use, and that chemical analysis of the water drawn from the river for the company's water-works in Indianapolis shows it to have deteriorated in quality. The injunction was granted to restrain the pollution on the ground that it was a nuisance, affecting the health and comfort of the public, and entailing a pecuniary loss upon the water company. An attempt to lessen the pollution by means of a large settling basin the court held to have been inadequate.

Owing to a break in the new water-works tunnel for the city of Milwaukee, the contractors, Schailer & Schniglau, of Chicago, refused to proceed with the work under the original contract, and the Board of Public Works has just ordered a "suspension of the contractors." There is talk both of the prosecution of the work by the city, and of a reletting of the contract. The tunnel was described in Engineering News of Oct. 25, 1890.

A derailing switch for street railway tracks to prevent collisions at crossings of steam railways has been brought out by Wm. Wharton, Jr., & Co., of Philadelphia, Pa. The switch is about 50 ft. from the crossing, and is normally set to derail. On approaching the crossing the car conductor runs ahead to an operating box placed between the rails of the steam track and by a key throws the switch and must hold the key in position until the car has crossed the switch, as on releasing or removing the key the switch is automatically set to derail.

The Mill Creek sewer, in West Philadelphia, Pa., is almost finished. This sewer was commenced 24 years ago, is four miles long, and drains an area of about 4,600 acres on the west side of the Schuylkill. It is 20 ft. in diameter at its mouth, diminishing to 7½ ft. at the upper end, and will cost, completed, about $1,000,000.

The Berlin metropolitan railway system is to be supplemented by an electric railway devised by Messrs. Siemens & Halske. The existing system, which in 1882 carried 9,000,000 passengers, now carries 33,000,000 per year, with the time interval reduced to a minimum and all tracks utilized for local traffic. The new system will include an east and west line, all on viaduct; a line from the Friedrichstrasse station to the heart of the city and then to the Grunwald suburb, of which a part in the city will be in tunnel, and a line from the same railway station north to Pankow. The gage will be 4 ft. 8½ ins., but the normal clear height, in tunnels and under bridges, will be only 10.33 ft., with a clearance width of 9.84 ft. The cars will be 7.38 ft. wide, have two trucks with an electric motor on each truck, and the estimated weight on each wheel is from 1.3 to 1.5 tons. The clear headway at street crossings is to be 14.46 ft.

The Stanserhorn mountain railway, in Switzerland, was opened to traffic in September. It is operated by cable without the use of rack rails, and is built in three sections, with a combined length of 2½ miles. The difference in altitude is 900 ft. for the first section, 1,640 ft. for the second, and a little over 2,000 ft. for the third and last. The grades range from 10 to 62%.

Forty railways, with a total mileage of 12,899 miles, have gone into the hands of receivers in 1893, says the New York "Times." The aggregate debt of these roads is $812,831,379, and the total stock amounts to $402,610,120. The principal roads in the above list, accounting for $642,637,811 of total debt, are the Erie, Reading, Northern Pacific and Union Pacific. As compared with the panic of 1874, the amount of stocks and bonds of railways defaulting in the first ten months of 1893 represented about one-eighth of the entire railway capital in the United States; while in 1874 about one-quarter of the entire bonded debt and about one-sixth of the stock was represented by the defaults of that year and 1873.

The "Lucania" and "Campania," of the Cunard Line, now hold all the records for trans-Atlantic travel. The "Lucania," on Oct. 20, made the eastern voyage in 5 d. 13 h. 30 m., thus beating the best previous record, made by the "Campania" last month, of 5 d. 14 h. 55 m. Her best run in a corrected day of 24 hours westward was 545 miles. The same week the "Campania" made the westward voyage in 5 d. 13 h. 25 m. She traveled over a course of 2,786 knots at an average speed of 20.88 knots per hour. The best previous westward record was that of the "Lucania," or 5 d. 13 h. 45 m.

An international test of American and European 6-pdr. rapid-fire guns is soon to take place at the Sandy Hook proving grounds. The guns entered will include the Hotchkiss, Maxim and Maxim-Nordenfeldt, Driggs-Schroeder, Seabury and Adamson types. It is hoped that the Sponsel Co., Schneider & Co. and Krupp may also enter guns for the test.

The most serious railway accident of the week, and by far the most serious of the numerous accidents which have occurred during the past few months, due to the lack of block signals and the running of so many extra trains for the Columbian Exposition traffic, was a rear collision at Battle Creek, Mich., on the Chicago & Grand Trunk Ry., Oct. 20. An eastbound excursion special with eight sleeping cars had orders from the operator at Battle Creek to stop at the end of the double track section through that city to let the westbound Pacific express pass. This latter train had 13 cars, many of them old day cars. The engineman, however, ran onto the single track, and the inevitable collision resulted. The engine and baggage car of the special were wrecked, but the substantially built sleeping cars were not damaged. The engine of the westbound train was wrecked, together with four cars, two of which were telescoped. The wreck caught fire and four cars were entirely destroyed, several passengers imprisoned in the wreck being burned alive. Many of the remains were unrecognizable, but 28 persons are known to have been killed, and about 25 were injured, some seriously. The conductor of the special claims that he gave the engineman the order as above stated, but the engineman claims that the conductor told him to hurry as the westbound train had already passed. An investigation is of course being made by the railway as to the responsibility, and the Railroad Commissioners will also make an investigation as to the cause of the wreck catching fire.

The following table shows the number of casualties in the recent great railway accidents. All but the first two accidents occurred to trains handling Columbian Exposition traffic, and were due primarily to the disturbance of train service by the number of extra sections and special trains being run for this traffic. Nevertheless, when the enormous increase of traffic is considered, the relative safety of railway travel probably remains unaffected by the increase in accidents.

Date.	Railway.	Location,	Accident.	K.	In.
Aug. 26	Long Island.....	L. I. City, N. Y....	Rear c.	16	30
Aug. 31	Bost. & Albany.	Chest'r, Mass......	Bridge	17	30
Sept. 7	Pitts. F. W. & C.	So. Chicago. Ill....	Head c.	12	19
Sept. 18	C., C., C. & St. L.	Manteno, Ill.	Rear c.	8	22
Sept. 22	Wabash.........	Kingsbury, Ind....	Head c.	11	17
Oct. 13	Mich. Central...	Jackson, Mich.....	Rear c.	12	30
Oct. 20	Ch. & G. Trunk.	Battle Creek, Mich.	Head c.	28	25

Another head collision of passenger trains occurred at Monroeville, O., on the Pittsburg, Fort Wayne & Chicago R. R., Oct. 22. The second section of a westbound train, while standing on the track, was run into by the second section of an eastbound train. A heavy fog prevailed at the time, and the engineman of the eastbound train stated that he did not know where he was. There were 25 persons injured, but only a few seriously injured.

A locomotive boiler explosion occurred Oct. 22 near Birmingham, Ala., on the Georgia Pacific R. R. The engine was hauling a freight train and was just starting to pull over a crossing when the boiler exploded, killing two men and injuring a third. The boiler of the engine of an express train on the Cincinnati, Hamilton & Dayton R. R. exploded Oct. 23, while the train was running near Raysville, O. The shock caused the derailment of the baggage car, but nobody was were seriously injured.

The third span of an old highway bridge across the Des Moines river at Eldon, Ia., gave way Oct. 18, and ten men were injured, and one killed. The structure was being taken down to make room for a new bridge. —A highway bridge over the Antelope Creek at O St., Lincoln, Neb., gave way under a ten-ton horse roller Oct. 17, and the driver was seriously injured. The structure had been condemned as unsafe.

The length of heavy guns is a problem now being closely studied by army and navy officers. Other things being equal, the longer the gun the more complete is the combustion and action of the powder on the projectile. In his report on progress in ordnance for the past year Lieutenant Qualtrough, U. S. N., says that at Elswick, a 6-in. gun, lengthened by screwing an additional piece on the muzzle, developed an initial velocity of 3,711 ft. per second with a 70-lb. shot, and 3,251 ft. per second with a 100-lb. shot. In recent experiments, a 6-in. gun 100 calibers in length is said to have given a velocity of 5,000 ft. per second, using an aluminum shell. In France, a 6.3-in. gun, 90 calibers long, has been fired over 100 times with 80 lbs. of smokeless powder and a 99-lb. projectile. An initial velocity of 3,900 ft. per second is said to have been gained with a pressure not much exceeding 16 tons. For the navy it is obvious that the length of the gun must be limited by available space, regardless of increase in velocity and energy. France has adopted a ruling length of 45 calibers for naval guns, and is experimenting with some small guns of 55 calibers in length.

The paid admissions to the World's Fair at Chicago, on Oct. 9, or "Chicago Day," was 716,881. If to this is added the admissions by passes, etc., the total attendance for that day foots up to about 762,000. The greatest attendance for any one day at the Philadelphia Centennial of 1876 was 274,919, and at the Paris Exposition of 1889 the maximum was 387,877. The combined figures, or 662,796, thus fall far short of the total admissions for the Chicago Fair on the day named, and though the full statistics for the Vienna Exposition are not available, it is possible that there is truth in the published statement that the admissions on Oct. 9 equalled the combined greatest attendance at Philadelphia, Paris and Vienna. The average daily attendance at Vienna was 39,003, as compared with 62,892 for Phildelphia and 192,281 for Paris, in 1889. From May 1 to Oct. 14, both inclusive, the paid admissions at Chicago aggregated 17,826,045, or a daily average somewhat above 100,000. Even if to this is added the 37,000 daily admission on passes, the aggregate still falls short of the Paris daily average. The total attendance at the last Paris Exposition was 28,149,353; though it must be said that Paris had four times the population to draw from within a 500-mile radius. The paid attendance at Chicago for the seven days ending Saturday, Oct. 14, was 2,121,794, an average of over 300,000 per day, including Sunday, and slightly more than double the attendance the preceding week.

WELL DRILLING PLANT AT THE COLUMBIAN EXPOSITION.

The sinking of wells to strike water, gas, oil, coal, etc., below the earth's surface is a very important industry in this country, and the work varies from sinking wells 100 to 200 ft. deep to supply farms with water, to sinking wells 2,000 to 4,000 ft. deep for city water supplies, etc. In the Exposition grounds, south of the boiler-house behind the Machinery Building, is an interesting exhibit of machinery and plant for this character of work. In the shallower wells two main conditions are encountered: 1, Where rock abounds; and, 2, where the material consists of sand, clay, gravel, etc. Portable rigs or machines, mounted on a frame, sometimes with engine and boiler on the same frame, and either self-propelling or hauled from place to place by horses, are very largely used for this class of work, and for prospecting. The best class of water wells drilled in this way are those in which the pipe lining is driven down from the surface to bedrock, thus shutting off surface drainage, the well being then drilled through the rock until the water bearing strata are reached. Some notes on artesian water supplies will be found in the report of the convention of the American Water-Works Association in our issue of Sept. 14, 1893.

The Oil Well Supply Co., of Pittsburg, Pa., has a large building designed and built by the Shiffler Bridge Co., of Pittsburg, in which is an extensive exhibit of various lines of valves, tools, tapping and threading machines, pipe, boilers and general supplies, and including drills and other machinery, and working models of different types of rigs and complete plants. Outside of this building are complete stationary and semi-portable drilling rigs, with derricks, engines, etc., and one of these has a plate girder walking-beam. A light portable rig for drilling about 600 ft. weighs about 4,000 lbs.; the drilling tools, etc., 960 lbs.; and the engine and boiler, 6,100 lbs. The deepest well drilled by this company has a depth of 4,618 ft. The exhibit includes two of the Glenn patent portable, self-propelling combined boring and drilling machines, having a vertical boiler at one end of the frame, and a vertical inverted engine mounted at the other end, close to the derrick. This is a new style of machine, patented in 1892, and is intended for work as deep as 800 ft., or even 1,000 ft., but for depths of over 800 ft. it is considered better to put in a semi-portable or stationary rig. Besides its large business in this country the company has sent many of its well drilling outfits, generally with a capacity for working as deep as 2,000 ft., to Europe, South America, Australia and other parts of the world.

The American Well Works, of Aurora, Ill., exhibit plants for operation by hand, horse and steam power, including a revolving boring machine (using a rotating auger instead of a vertically striking drill), and their special elliptical drilling machine fitted with elliptical gears, thus getting a quick drop and slow rise. They have also a special steam plant for hydraulic jetting. This firm's plant, as used for the 2,920-ft. well for the water supply of Galveston, Tex., was described and illustrated in our issue of Aug. 11, 1892; and its well drilling plant on wheels, with separate portable engine, in our issue of Dec. 15, 1892. A separate exhibit of well pumps, pipe, casing,, perforated pipe joints, etc., is in the Machinery Building.

The F. C. Austin Mfg. Co., of Chicago, has its exhibit of well sinking machinery located in the annex of the Agricultural Building. It shows three machines: 1, A portable rock drilling machine (the Austin No. 2); 2, the same machine with engine mounted on the same frame and trucks; 3, the Austin jetting machine. The Austin No. 2 portable rock drilling machine is adapted for sinking domestic and farm wells in rock. It is mounted on a strong frame carried on wheels, and works on what is known as the cam and treadle principle. The treadle is a hinged beam, on the free end of which is a sheave, around which the drill rope passes. Above the free end of the treadle is a shaft carrying two semi-circular cams, which in their revolution depress the treadle, thus raising the drill by the rope, and allowing it to drop when the cams free the end of the treadle. The shape of the cams is such as to prevent jar when they strike the treadle, and as they straddle the rope the drill is given a long drop with a low expenditure of power. The drill can be given 50 to 60 drops per minute. All the operating levers (controlling the hoisting, the worm feed, the ratchet, the sand pump and the treadle catch) are within reach of the operator. We are informed that many hundreds of these machines have been built during the past eight or ten years. The jetting machine is designed for drilling in soft formation. The drilling motion is very similar to the above, but the machine is provided with two powerful jetting pumps, which are arranged with an air chamber to relieve the pressure on the hose. The discharge from the pumps is conveyed by wire-wound hose to a jetting swivel at the upper end of the hollow drill rods. On the lower end of these rods is attached the bit or cutting tool, and the joint action of the vertical stroke and the force of the water cut through the earth and wash the debris to the surface, thus saving the time otherwise occupied in taking out the drill and introducing the sand pump to clean the hole. The machine exhibited includes all recent improvements in its class.

Morgan, Kelly & Taneyhill, of Waterloo, Ia., exhibit drilling rigs with and without the boiler and engine mounted on the same frame; and their machines are used mainly in the Northwest for drilling for water for farm supplies, etc. In the former case the rig may be operated by a horse power gearing. Where the steam power plant is mounted on the frame, it consists of a vertical boiler and vertical inverted engine on the same bedplate, so that in winter or at other times when the machine is not in use they can readily be removed and used for driving feed cutters or other farm machinery. The frame is low down, near the ground, and carries a folding derrick. These engines have no traction attachment. The depth of work is from 250 to 500 ft. A pipe driving attachment is fitted for driving the casing in loose material, the driver being attached to the slack of the rope after the tools have been withdrawn. The driver moves on guides, and the pipe is held vertical by a follower running on the same guides. The usual lines of drills, tools and supplies are furnished, and the firm has a specialty in well boring machines (using augers instead of drills) and also furnishes the Smedley pump (Dubuque, Ia.), and a vertical steam pump for deep wells.

The Star Drilling Machine Co., of Akron, O., exhibits two machines, one fitted with traction gear and intended to drill to 250 ft.; and the other mounted on carrying wheels (for animal traction) and intended for work as deep as 1,200 ft. The company makes its machines in nine sizes, and has about 500 of them in use in this country, Mexico, Central America and Australia. The majority of the smaller machines are mainly used for drilling for private water supplies, and these machines have T or bootleg boilers, while the larger sizes have vertical boilers. The boiler is placed at the rear of the frame, over the main axle, and the vertical engine (with inverted cylinders) is placed over the front axle. The walking-beam is pivoted near the middle of its length. The Miller patent spudding and pipe driving attachment is used, and the special feature of the spudding attachment is in passing the drill rope round a pulley carried on the end of an eccentric rod, the motion of the eccentric giving the pulley an oscillating movement. The stroke for spudding is from 30 to 40 ins., and the tools can be given this stroke about 60 times per minute. The ordinary depth of spudding a well, before using the walking-beam and drill, is about 200 to 300 ft., or even 400 ft. The larger sizes of machines have folding ladder derricks. The 250-ft. machine has a frame 15 ft. long and 3 ft. 4 ins. wide, of sills 4 × 10 ins., a 13-ft. walking-beam, 4-HP. engine with cylinder 5 × 5 ins., link valve gear, 54-in. band wheel and 48-in. bull wheel, and weighs about 3,000 lbs., without the traction gear. Its derrick is 26 ft. high. The 1,200-ft. machine has a 10-HP. engine with cylinder 7 × 8 ins., T-boiler, and ladder derrick 32 ft. high. This machine weighs about 5,500 lbs. The machine is fitted with a small fan or blower, made by the Akron Heating & Ventilating Co. The depth of drilling varies in different portions of the country, but is said to average from 250 to 350 ft. in New York, Pennsylvania, Ohio, Indiana and Kentucky. The company has drilled oil wells 2,500 to 3,550 ft. in depth.

The Keystone Driller Co., of Beaver Falls, Pa., shows a single-beam traction or self-propelling rig. At the back end of the frame is a vertical boiler, with cross tubes, in front of which is the engine, with vertical cylinder 8 × 8 ins. This end of the frame is carried by the traction wheels, which have steel tires 10 ins. wide. At the front end of the frame is the hoisting gear for the rope and attachments, the walking-beam extending the whole length of the frame and being pivoted at the back end, while its motion is given by a vertical connecting rod from a wheel at the front end. The traction gear is made for two speeds, two and five miles per hour, either of which can be made available at will, according to the grade and condition of road. The machines are made in sizes for drilling holes 3 to 6 ins. diameter and 100 to 2,000 ft. deep, the larger sizes having a double beam, worked by two connecting rods. A special attachment is used for spudding in the tools or starting the work, and this is sometimes used all the way down for depths not exceeding 125 ft., while it is also available as a pipe driver.

AN ABNORMAL VALVE GEAR.

Probably a good share of the engineers and mechanics who spent some time in the Transportation Building at the World's Fair looked at the locomotive in the French section exhibited by the French state railways, and wondered with great wonderment what on earth that curious contraption on top of the valve chest was supposed to be.

For the benefit of any of our readers who may have had their curiosity thus excited, we show herewith an elevation and sections of this valve gear. Although complicated in appearance, its working is easily understood. It is simply an independent cut-off valve gear working in connection with a link valve gear which operates valves for independent steam and exhaust ports. The link gear is used for reversing, but the reverse lever is not used to govern the cut-off, but is kept in full gear forward or backward. The cut-off is regulated by the double-helix tappet arrangement shown in the drawings. The rod which carries this double-helix is so connected to the other parts of the valve gear that it has a short reciprocating motion, and the point at which the helix strikes the tappets is adjusted by rotating the rod on which the helix is fixed. These tappets form one arm of a bent lever, the other arm of which acts as a catch and stops the end of the rod to which the cut-off valve is attached, as shown in the sectional view. The cut-off valve is moved by a piston and by a spring. The space behind the piston is connected with the steam passage way by a check valve which allows steam to pass in behind the piston, but prevents its exit. When the exhaust port opens, the pressure on the right-hand side of the piston is relieved, and the confined steam behind the piston forces it with its connected parts to the right, compressing the spring on the end of the rod. When the steam pressure comes again on the right-hand side of the piston the spring tends to force it back to the left; but the catch connected with the tappet has dropped into place and prevents this movement and the consequent cut-off of the steam until the latch is released by the tappet. Further details of the working of the various parts will be found by examining the accompanying drawings.

One can imagine the reception which the inventor in this country would meet if he laid the drawings of this complicated apparatus before the average hard-headed railway master mechanic. The French, however, have a certain liking for what seem to an American fussy complications; and the Bonnefond valve gear has been applied to eight locomotives on the French state railways. Of course, the advantage claimed for this gear is that it avoids the throttling of the steam in the ports which occurs with the link motion when working at short cut-off and high speed. The locomotives fitted with this gear are said to have proved quite remarkable for free running at high speeds. An economy in coal consumption is also claimed for this gear, and, in proof thereof, the coal performance sheet of an engine fitted with this gear is compared with the other engines on the road which are fitted with the Walschaert valve gear. These engines showed an average consumption of 31½ lbs. of coal per train-mile, or 252 lbs. per 1,000 ton-miles. The engine with the Bonnefond gear burned 29 lbs. per train-mile and 227 lbs. per 1,000 ton-miles. As the engine with the new valve gear had 55 lbs. higher pressure and nearly 50% more grate area, it is not evident that any great credit was due the valve gear for fuel economy.

Perhaps some time the railways of this country will find it worth while to adopt a valve gear giving a better steam distribution than the link motion; but it is pretty safe to say that a valve gear will have to be a much simpler affair than that illustrated herewith if it is to find much favor in American railway circles.

THE TESTING AND USE OF PORTLAND CEMENT IN EUROPE.

Considering the vast amount of Portland cement used in engineering construction, our knowledge concerning the qualities best adapting it for use in various conditions and the tests best adapted to determine these qualities is very tentative. In European countries much work has been done in recent years, however, to place the question upon a less experimental basis, and some of the results of this work are embodied in papers recently read before American and foreign engineering societies by Messrs. Henry Faija, of England; Max. Gary, of Germany, and H. Le Chatelier and R. Feret, of France, all well known engineers who have given the subject considerable study. These papers touch upon the various points of the testing and use of Portland cement in the three countries named, which, including Belgium, manufacture by far the largest part of the Portland cement used in the world, and the following notes, which seem to be of most interest, are abstracted from them.

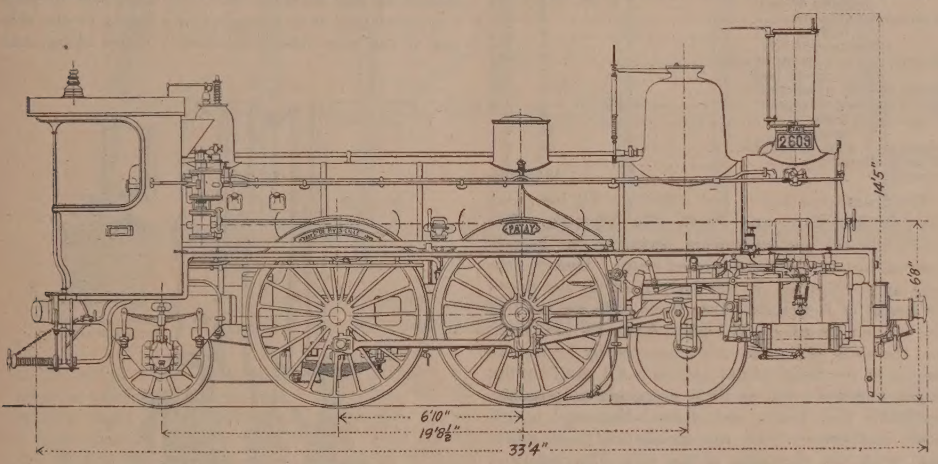

FIG. 1. EXPRESS LOCOMOTIVE WITH BONNEFOND VALVE GEAR. EXHIBITED BY THE FRENCH STATE RAILWAYS AT THE COLUMBIAN EXPOSITION.

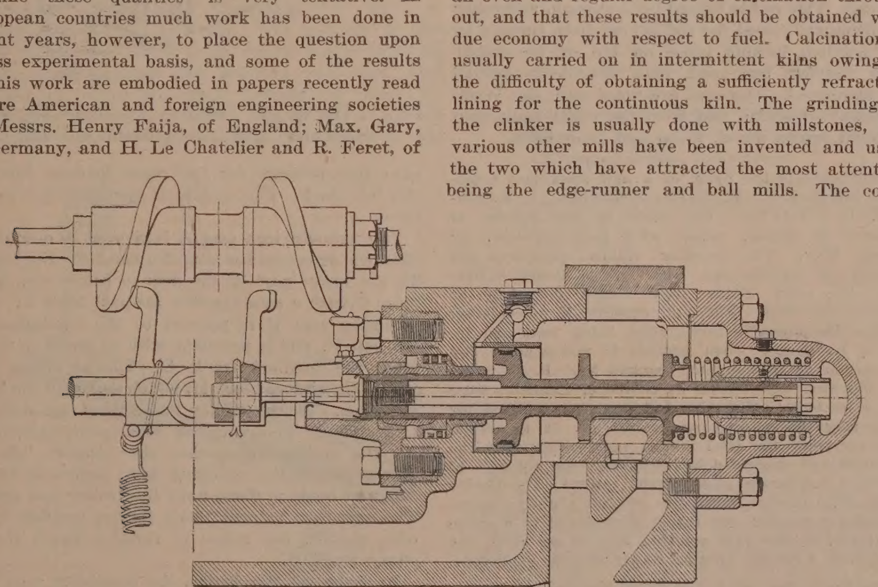

FIG. 2. DETAILS OF INDEPENDENT CUT-OFF VALVES, BONNEFOND VALVE GEAR.

The Manufacture and Testing of Portland Cement in England.

In a paper read before the division of the International Engineering Congress, conducted by the American Society of Civil Engineers, Mr. Henry Faija, M. Inst. C. E., claims that in manufacturing Portland cement the materials which are capable of reduction by water are not only the most economical to use, but produce the highest quality of cement because they can be more perfectly mixed mechanically and the chemical action produced by calcination is more complete. The chalks and clays on the Thames and Medway in England, and at Yankton, S. Dak., in the United States, are examples of materials which lend themselves easily to disintegration by water. Other raw materials which are not capable of reduction by water have to be ground to powder and then mixed. The means adopted for drying this mechanical mixture are various, but the most advanced method is to construct the drying floor at the level of the top of the kilns and to use the waste heat of the kilns for drying. The requirements for calcination are: That it be stopped just short of vitrefaction; that it be effected rapidly; that the clinker be burned, not baked; that the product of a kiln should show an even and regular degree of calcination throughout, and that these results should be obtained with due economy with respect to fuel. Calcination is usually carried on in intermittent kilns owing to the difficulty of obtaining a sufficiently refractory lining for the continuous kiln. The grinding of the clinker is usually done with millstones, but various other mills have been invented and used, the two which have attracted the most attention being the edge-runner and ball mills. The comparative economy of these mills in the consumption of power is as follows:

Millstones	30 to 32	I. H. P. per	ton per	hour.
Ball principle....	16 o 18	“	“	“
Edge-runner......	12 to 14	“	“	“

The more floury a cement is, the better it is, other things being equal, and in this respect millstones are superior to other mills.

In testing cement a very true knowledge of its value may be obtained by determining: (1) The time which it takes it to set; (2) soundness or freedom from blowing; (3) the fineness to which it is ground, and, (4) tensile strength at three or seven days. The specifications for a cement, should require: (1) The fineness to be such that it will all pass through a sieve having 625 holes per sq. in. and leave a residue of only 8% on a sieve having 2,500 holes per sq. in.; (2) that a pat made and submitted to the moist heat and warm water test advocated by the author (Trans. Am. Soc. C. E., Vol. XVII., Eng. News, Aug. 24, 1893) shows no signs of expansion or contraction in 24 hours; (3) that it withstand an average tensile strain of 250 lbs. per sq. in. in three days, and of 350 lbs. per sq. in. in seven days, the strain to be applied at the rate of 400 lbs. per minute. In regard to the increase in strength, Mr. Faija says:

> If a 28-days test is required, the average tensile strength should be at least 450 lbs. per sq. in., and it must be noted that the increase in strength developed between the different dates is an indication of the growing strength of the cement, and admits of an approximation being formed of its ultimate strength. It is impossible to lay down any hard and fast rule as to what the increase between the different dates should be. A slow setting cement will probably increase 50% between the three and seven days test, and 25% between the 7 and 28 days; whereas, a quick-setting cement may increase but very little. All cements should, however, show an appreciable increase in strength between the different dates; but as the increase in strength is not so great with quick-setting cements as with slow-setting ones, the tensile strength of a quick-setting cement should be greater at the shorter dates than a slow-setting one. All cements, more especially quick-setting ones, become slower setting and generally improve in tensile strength with age.

The Testing of Portland Cement in Germany.

While in France, England, Australia, America and other countries where cement is largely used, certain rules, which have gained recognition through tradition and development are considered sufficient, the methods of manufacturing and testing Portland cement in Germany are determined by rigid and comprehensive regulations. In a paper read before the International Engineering Congress by Mr. Max. Gary, of Berlin, the development and scope of these regulations were discussed at some length. The prime mover in this work has been the Association of German Cement Manufacturers, and we give the most important of the regulations adopted by it:

1. Packing and Weight.—As a rule, Portland cement must be packed in standard barrels containing 180 kg. (396 lbs.) gross, and about 170 kg. (370 lbs.) net, and in half barrels of 90 kg. (198 lbs.) gross, and about 83 kg. (183 lbs.) net. The gross weight must be marked on the barrels. In case the cement is wanted in barrels of different weight or in sacks, the gross weight must likewise be plainly marked thereon. Leakage, as well as possible variations in individual cases, are allowable to an extent of 2%. The barrels and sacks, besides the weight, must also be plainly marked with the name or trade-mark of the manufacturing firm.

2. Time of Setting.—According to the purpose for which it is intended, quick or slow setting Portland cement may be demanded. Slow-setting cements are those that set in about two hours or more.

3. Constancy of Volume.—The volume of Portland cement should remain constant. The decisive test of this should be that a cake of neat cement, made on a glass plate, protected from sudden drying and placed under water after 24 hours, should show, even after long submersion, no signs of crumbling, or of cracking at the edges.

4. Fineness of Grinding.—Portland cement must be ground so fine that no more than 10% of a sample shall pass through a sieve of 900 meshes per sq. cm. (5,800 per sq. in.). The thickness of the wires of the sieve to be one-half the width of the meshes.

5. Tests for Strength.—The binding strength of Portland cement is to be determined by testing a mixture of cement and sand. The test is to be conducted for tensile and compressive strength according to a uniform method, and is to be performed upon test specimens of like form, like cross-section, and with like apparatus. It is recommended, besides, to determine the strength of neat cement. The tests for tension are to be made upon briquettes of 5 sq. cm. (0.78 sq. in.) cross-section at the place of rupture, the tests for compression upon cubes of 50 sq. cm. (7.8 sq. ins.) area.

6. Tensile and Compressive Strength.—Slow-setting Portland cement, when mixed with standard sand in the proportion of 1 part of cement to 3 of sand by weight, 28 days after being mixed—one day in air and 27 in water—must possess a tensile strength of not less

than 16 kg. per sq. cm. (225 lbs. per sq. in.), and a maximum compressive strength of 160 kg. per sq. cm. (2,250 lbs. per sq. in.). Quick-setting cements generally show a lower strength after 28 days than that given above. The time of setting must, therefore, be given when stating figures relative to strength.

Proportions of Cement Mortars in Sea Works.

A proper proportion for cement mortars to be used in sea water is fully as important as the good quality of the cement used in the mortar. In a paper presented at the recent meeting of the International Maritime Congress, in London, Mr. R. Feret, Chief Engineer, Ponts et Chaussees, Boulogne, France, gives some interesting information regarding this point. He states that not only is the same mortar unsuitable for different works, but even for different parts of the same structure. The proportion, also, of a particular cement, which should be mixed with a given quantity of sand to form mortar of a certain quality, varies within very wide limits, according to the nature, and especially the size, of the sand used. This is shown by the following table compiled from experiments made by Mr. Feret:

Compressive strength after 5 mos. in sea water, lbs. per sq in.	Weight of cement to unit weight of sand.		Volume of cement to one volume of sand.	
	Coarse.	Fine.	Coarse.	Fine.
500	0.09	0.21	0.1	0.2
1,000	0.15	0.31	0.16	0.34
1,500	0.2	0.45	0.22	0.44
2,000	0.25	0 54	0 27	0.53
2,500	0.29	0.63	0.33	0.62
3,000	0.35	0.73	0.39	0.72
3.500	0.41	0.86	0.46	0.84
4,000	0.5	1.04	0.56	1.02
4.500	0.62	1.26	0.69	1.24
5,000	0.82	1.58	0.92	1.56

The figures show that it is necessary to use about twice as much cement with fine sand as with coarse to obtain the same strength of mortar. The engineer should investigate the sand at his disposal in each case in order to find the best proportion of cement to mix with it, and all proportioning by analogy from what has been done in other places with other sands should be avoided. The best way to make these tests is to make a number of samples of mortars with increasing proportions of cement and to test these mortars in reference to their special use; i. e., strength, imperviousness to water, resistance to the chemical action of sea water, etc. In mixing the sand, cement and water, all three ingredients should be proportioned by weight. The proper course for making mortar on the works is given by Mr. Feret as follows:

(1) To institute preliminary experiments for selecting the best sand available, and ascertaining the best proportion by weight of cement to mix with this sand. (2) To calculate from these proportions the weight of sand corresponding to one or several sacks (or barrels) of cement. (3) To measure, under the same conditions as on the works, the weight of a known volume of sand and deduce the volume of sand which should be mixed with a suitable number of sacks or barrels of cement. (4) To repeat frequently this measurement through the whole period of the work, so as to keep account of possible changes in the condition of the sand, and make the necessary corrections in the volume of sand to be employed, so that the real proportions of the sand and cement used may remain constant.

The Testing of Cements in France.

In a paper presented before that division of the International Engineering Congress conducted by the American Institute of Mining Engineers Mr. H. Le Chatelier, Professor at the Ecole des Mines, Paris, discusses at length the testing of hydraulic limes and cements. The conclusions arrived at are that in the present state of knowledge and practice the following tests are to be recommended:

(1). Fineness of grinding, according to the residue from a sieve of 900 meshes per sq. cm. (5,850 per sq. in.). (2). Resistance to crushing, determined upon blocks of mortar composed of 1 part of cement to 2 of sand, tempered to plasticity; the sand having a uniform grain of about 1 mm. (0.04 in.) diameter and the blocks being cubes of 70 mm. (2.8 ins.) or cylinders 2.5 mm. (1 in.) in height and diameter. (3). Invariability of volume in boiling water. (4). Rapidity of setting, the mortar being composed of 1 cement to 2 sand, and tempered to normal consistency. (5). A fifth test, for the detection of aluminates, should be the object of investigations conducted in the hope of becoming able to foretell the stability of cements in air or sea-water.

ORE CAR; DULUTH & IRON RANGE R. R.

(With inset.)

Cars especially built for carrying ore resemble in general type the drop bottom gondola cars used for coal traffic, as illustrated and described in our issue of March 9, 1893, but ore cars are usually shorter and of heavier construction than coal cars of equal capacity, owing to the greater weight of the ore. The interior of the body, also, generally has the four sides inclined, and at a steeper angle than the sides of coal cars in order to facilitate the discharge of the load. We present this week the drawings of the standard type of ore car of the Duluth & Iron Range R. R., which has a carrying capacity of 24 gross tons. The cars were designed a little more than a year ago by Mr. H. S. Bryan, Master Mechanic, to whom we are indebted for the drawings from which our inset sheet has been prepared. About 500 of these cars are now in service. The bill of lumber is given with the drawings, and the general dimensions of the cars are as follows:

	Ft.	Ins.
Length over end sills	22	0
" " body	21	2
" " couplers	24	6
" of top of box	17	6
" " bottom of box	7	9¾
Width over side sills	8	0
" " body	8	0
" of bottom of box	3	7½
Height, rail to bottom of sill	3	9¾
" rail to top of body	7	7½
Depth of body at hopper	3	9¾
Size of bottom of hopper 7 ft. 9¾ in. ×	3	7½
Wheel base, truck	5	4
" " total	19	0
Distance c. to c. of trucks	13	8
Wheels, diameter	2	9
Capacity	53,760 lbs.	

The frame has heavy end sills 9¾ × 9¾ ins., and side, intermediate and draft sills 5¾ × 9¾. The draft sills are not continuous, owing to the hopper bottom, but are let into a cross-beam. Heavy timbers across the top of the body hold up the doors by means of iron rods. Two truss rods are used to the bottom framing. The planks are 1¾ ins. thick and the ends of the box are supported by braces, as shown in the longitudinal section. All the framing is put together with as little mortising as possible, malleable iron heads and shoes being used on all posts and braces. All the woodwork is of white oak, with the exception of the side sills, side and end rail, and deckbeams. There are two openings in the hopper bottom, each closed by two drop doors, as shown, the two doors of each pair being locked when closed by a T-foot on a vertical rod passing through a heavy beam across the top of the car. This rod is turned by a wrench, and when the doors are closed the rod is kept from turning by the notched locking plate on top of the beam. Link couplers are used, with deadblocks behind the drawhead. The cars are fitted with the Westinghouse air-brake, and with the usual equipment of hand brake wheel, steps and grab irons.

Schnebelite is the name of a new smokeless explosive, invented by M. l'Abbe Schnebelin, a Frenchman. It is said that the basis of the powder is chlorate of potash, mixed with pure cellulose, or woody fiber. The inventor claims cheapness and facility of manufacture; that it is almost smokeless; has very slight recoil; does not foul or oxidize the rifle; will not explode if unconfined; retains its properties even after being wet, and involves no danger when heated; is non-explosive by concussion or friction and requires 540° F. to ignite it. The late experiments at Nunhead, England, were far from being exhaustive and no means existed for measuring the velocity or penetration. It is stated, however, that the trial proved conclusively that the inventor had succeeded in producing from chlorate of potash a powder completely under control. The powder made little smoke; fouled the gun but slightly; coarse granulated powder was safely ground fine in a coffee mill; and it was also pounded fine on an anvil and fired with a match, burning slowly without explosion.

The North Sea and Baltic Canal, the greatest work of this type of the present time, is approaching completion. About 80,000,000 cu. m. of material have been moved and $17,500,000 has been expended out of an estimated total cost of $39,000,000. This 60 miles of canal is to connect the Baltic, at Holtenau, with the North Sea, at Brunsbuttel, near the mouth of the Elbe. About 5,000 men were at work during the past summer. The men receive the high wages, for Germany, of 42 cts. to 72 cts. per day for ordinary labor, and 96 cts. to $1.44 per day for piecework. This canal was fully described in Engineering News of March 26, 1892.

THE LIDGERWOOD TRANSFER FOR COALING SHEDS.

We illustrate in the accompanying cuts an application of the cable-way in a modified form to locomotive coaling sheds which has recently been made by the Lidgerwood Mfg. Co., of New York city. The principle upon which the device is operated is very similar to the ordinary horizontal cable-way, except that the trolley from which the fall block is suspended runs on iron or wooden beams instead of on a wire rope. An enlarged sketch of the trolley and fall rope carrier is shown in Fig. 1, and in Figs. 2 and 3 is shown the general arrangement of the transfer as applied to the coaling shed of the Boston & Maine R. R., at South Lawrence, Mass.

From Fig. 1 it will be seen that the trolley has four wheels, and runs on tracks supported on iron channels or wooden beams. The hoisting rope passes over idler sheaves which run on the same axles as the trolley wheels (see Fig. 1). The hoisting rope then loops downward around a block, from which the hoist hook is suspended, as seen in Fig. 4.

The feature of special interest in the apparatus is the use of carriers for the fall rope which are attached to the beam on one side only, and in such a manner that they automatically swing to one side out of the way when the trolley comes along, and give free passage for the ropes leading down to the fall block. The details of operation are as follows:

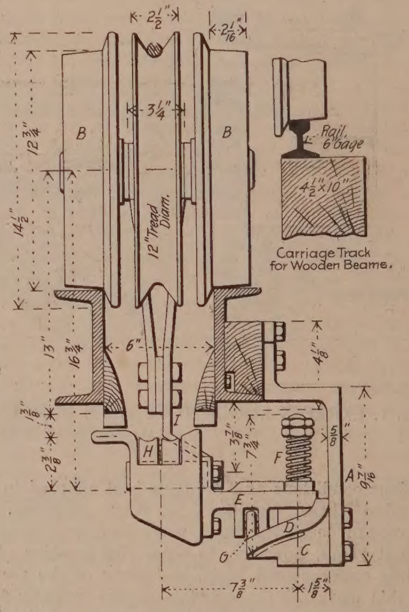

Fig. 1. Trolley and Swinging Fall Rope Carrier for Hoist and Transfer Using Beams as Track.

The wrought iron arm A is riveted to one of the channels or beams forming the track for the trolley. To the lower part of the arm is bolted the trackpiece C with a semi-circular inclined track D. The swinging arm E is pivoted to the trackpiece by the bolt F, and is provided with a wheel G to run upon the inclined track D. The swinging arm carries the sheave block H, which supports the hoisting rope.. To the trolley is attached the deflector I, a strip of iron with its ends inclined outward. As the trolley approaches the support, the deflector strikes the swinging arm, pushes it to one side and holds it there until the trolley has passed. The arm then returns to its former position by its own weight, the wheel G running down the inclined track D.

In designing the device, the possibility was foreseen that at times, when running rapidly with slack rope, the rope might drop down before the carrier swung back in place. If this should occur, however, the drop of the rope below the carrier can do no harm as long as it runs slack. When it is tightened by the approach of the trolley, the rope comes against the under side of the sheaves on the carrier and exerts a lifting force on the swinging arm. As soon as this becomes equal to the combined weight of the carrier and the pressure of the spring which holds the swinging arm down, the arm revolves to one side, letting the rope rise above it.

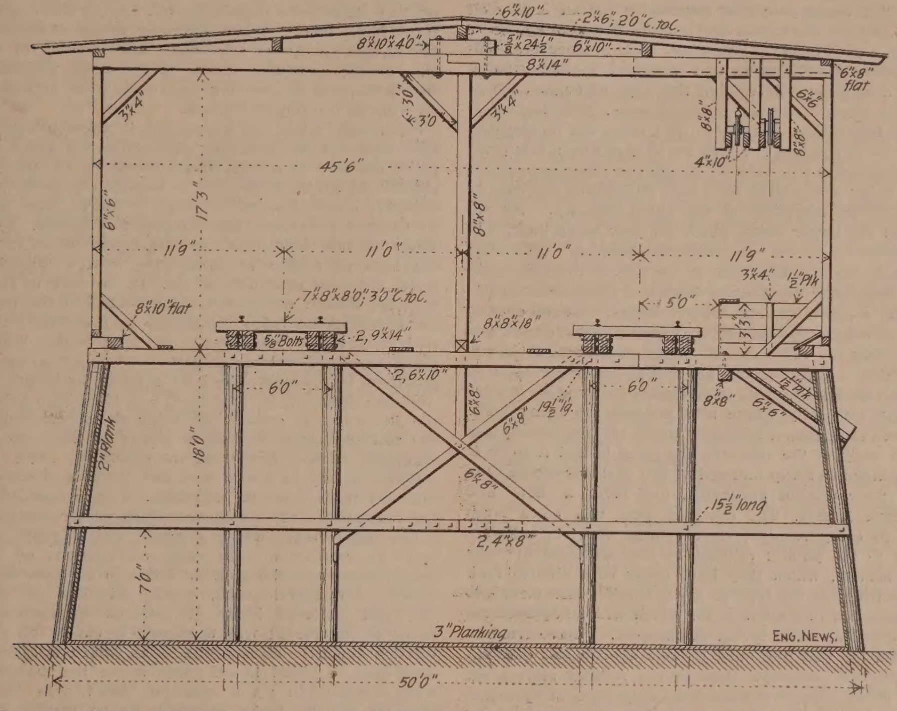

FIG. 2. CROSS SECTION OF LOCOMOTIVE COALING STATION WITH LIDGERWOOD HOIST AND TRANSFER AT SOUTH LAWRENCE, MASS.; BOSTON & MAINE R. R.

Besides the novel features in connection with the transfer, the general arrangement of the coaling station is quite unusual. As the space for the approach track was limited, the elevated tracks had to be set at a low level in order not to have too steep a grade on the approach. The space for the station itself was also limited, and hence, to get a large storage capacity with the low level tracks, the site of the station was excavated to a depth of 6 ft. This whole area was covered with 5 ins. of concrete asphalted on the top, and the coal is dumped from the hopper bottom cars directly on this floor. Thus, the whole space covered by the station roof is a huge bin, which may be filled to the level of the track if desired, and when so filled holds about 7,000 tons. The transfer is used for filling the chutes from which the locomotives take their supply. The hoisting tubs used hold 1,000 lbs. each, and when lowered are placed on low cars which can be easily wheeled on the smooth asphalt floor to any desired point. When the shovelers fill a tub it is wheeled underneath the line of the transfer, which picks it up and dumps it into any bin desired.

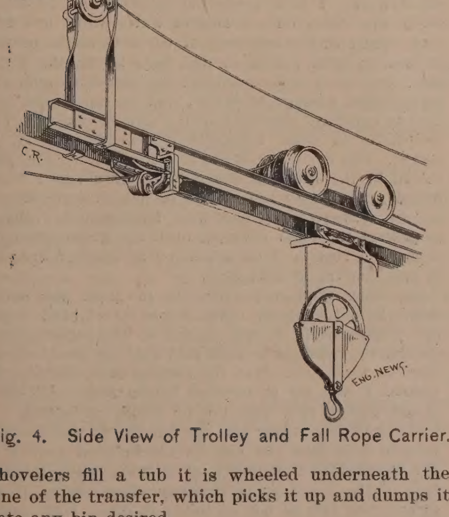

Fig. 4. Side View of Trolley and Fall Rope Carrier.

The force required to operate this coaling station consists of an engineer at $2 per day, a dump boy at $1 and three shovelers at about $1.50 each. Adding 50 cts. for coal and other supplies for the engine used to operate the transfer, the operating expenses of this coaling station may be taken at about $8 per day. About 20 locomotives per day coal at the station, and allowing five tons each, we have an expense of 8 cts. per ton for operating the station. We understand, however, that the present force could supply coal for double the number of engines if required, which would make the expense of handling by this system when worked to its full capacity only 4 cts. per ton.

DIRECT DRIVEN GENERATORS.*

Back in the early eighties the different manufacturers in Europe, including Brush, Siemens & Halske and others, commenced the building of direct-driven generators of small capacities connected to different types of engines, operating at a high rotative speed. Among these were a large number of Brush machines connected to Westinghouse engines. About the first apparatus for use in central power stations were those designed and built by Mr. Edison for the old Pearl St. station in New York city. These machines were about 300-HP. capacity, directly connected to an Armington-Sims automatic, single cylinder engine, operating at about 250 revolutions. These are still in use, except a few which were destroyed in a fire in the station several years ago. There is also a large power station operating in Milan, Italy, with the same type of apparatus. Although it is now nearly ten years since these particular units were built, it is only within the last two years that we have commenced their introduction to any general extent on large power station work. Although these units operated in general in a satisfactory manner, the types of generator and engine were not perfected generally to give the best of service, and therefore electric manufacturers abandoned their development after these first ones and returned to belt-driven generators, and they continued to be the standard type of power station generators until two years ago.

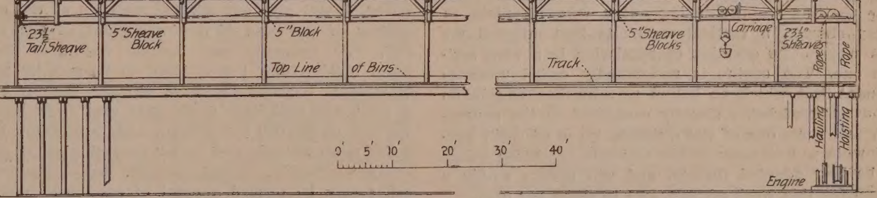

FIG. 3. SIDE ELEVATION OF SOUTH LAWRENCE COALING STATION.

In Europe, however, the development of their electric apparatus has been slower, and they have, therefore, had more time to work up special designs and perfect different types of generators. The general commercial requirements were not so rushing, and when American manufacturers commenced to develop direct driven generators to a large extent, they found their co-workers in this line in Europe far ahead of them, in that they had several years ago a number of large stations in Berlin, Paris, London and other parts of Europe operating with units up to 1,000 HP., directly connected to different types of engines, principally vertical ones. The writer remembers in 1887 and 1888, when he was connected with one of the electric manufacturing companies, the difficulty he had to get the shops to build the first small direct-connected generator for naval service. This really commenced the development of this type of apparatus with American manufacturers, and the old Edison, Thomson-Houston and Westinghouse companies commenced building them in small units. None of the foregoing generators, although for different types of central station and power work, were used on electric railway work. Commencing in 1890 the Thomson-Houston, Edison, Westinghouse, and later the Siemens-Halske company of America, commenced designing and building railway generators for direct connected work, and during the past year there have been quite a number of new stations operated and building, which are equipped entirely with direct-connected generators, running in size all the way from 100 K.-W. to 1,500 K.-W.

The direct-driven generators now built by the different manufacturers are in a large measure of the same general construction, so far as general details go, differing in minor points only. I have taken for illustration the more permanent to give a fair and intelligent representation of this type of apparatus. The Westinghouse generator coupled direct to the Westinghouse engine by their well known method of flexible clutch coupling was one of the first direct-connected machines to be introduced on railway work, and is now built and operating in units up to 375 K.-W. on railway work and up to 1,000 K.-W. for power, in a large number of stations throughout the country. The generator is a multipole machine, with iron-clad slotted armature, and is built entirely separate from the engine in all respects. The principal point of difference in this unit between that of other manufacturers is in the method of the connection to the engine, which is by flexible coupling, the engine and generator having separate shafts. The generator resembles the belted machine built by that company. The rotative speed of this direct-connected machine is somewhat higher than those of the other manufacturers of the same capacity, but operated as it has been generally with the Westinghouse engine it has proved itself so far a well constructed and good operating machine.

The Siemens-Halske Co. has the advantage of the development of this machine by its company in Europe, which development commenced, as previously stated, in these large units, considerably before that of the American manufacturers. This company's machine is mounted directly on the shaft of the engine, from which it operates, which shaft is supported at the outer end by an outboard bearing. In this type of machine the electromagnets are placed inside of the Gramme ring. By this arrangement the diameter of the armature is largely increased and the peripheral velocity is great even with a slow rate of speed, making the machine specially adapted for direct connection. The field magnets are bolted to the pillow block of the main shaft, and the ring-shaped armature keyed on outside the magnets to the main shaft like a flywheel, and the outer end of this shaft is supported as stated by an outboard bearing. This machine is not provided with any special commutator; armature winding is on solid copper bars, on which the brushes rest.

The generator of the type developed by the old Edison company for central power station work is what is termed the smooth body type of armature. The armature bars consist of solid copper U-bars slipped over the core or body of the armature, the brushes bearing on the head or end of the same. These machines have proved good operating machines, and there are a number operating on railway work in Milwaukee. One of the generators in the power station of the Intramural Railway at the Columbian Exposition is an 800-K.-W. machine, manufactured by the General Electric Co., and has that company's iron-clad body type of armature, which is the type it is specially developing for railway power work. This machine is self-supporting in that the armature is not mounted on the engine shaft, but has its own separate shaft, and is coupled to a vertical type of compound marine type of automatic engine, manufactured by the Lake Erie Engineering Works. This unit is next to the largest which has been built for railway work, and has been in continual service in this power house since the day it started, July 4, and has operated almost wholly the entire service of the electric elevated railway. The engine and generator have stood an overload as high as 80% above their rated capacity, and seem to be especially adapted to stand severe strains of railway power work. While the generator is not quite so compact in floor space as those which are mounted directly on the engine shaft, it seems to possess in many respects desirable points as regards engine and generator connections for railway power based on practical experience and its operation on this severe work, and has already resulted in its adoption for several large plants.

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*Abstract of a report presented by Mr. C. J. Field at the annual convention of the American Street Railway Association, Oct. 18 to 20, at Milwaukee, Wis.

Another large generator for railway work, built by the General Electric Co., is double the capacity of the foregoing and is of the same general type. This generator was designed and built for operating in several large power plants which are now being built, among them being that of the Brooklyn City R. R., where six of these units are being put in operation, and another is operating in the power house of the Intramural Railway at the Columbian Exposition, in connection wth a cross-compound Reynold's Corliss type of engine. On account of the general construction arrangement of the engine the generator is mounted directly on the engine and alongside the flywheel. The field magnets on both this generator and the 800-K.-W. machine above mentioned are so arranged that by turning a crank the magnet frame can be moved to one side, leaving the armature entirely accessible for removal or repair. This generator has not as yet been extensively operated in regular service, but has been used sufficiently to demonstrate that it is a well-designed machine and has shown its ability to carry the same proportion of overload as the 800-K.-W. machine.

The type of engine to use in connection with the operation of direct-driven generators is one of the serious factors to consider in this connection. There are many points to be considered of economy, reliability, continuous service, good regulation, ability to stand the direct and severe shocks due to overloading generators, short circuits, economy in floor space, etc. On the question of whether the vertical or horizontal engine is better adapted, common sense seems to indicate that as we are laying out a compact plant in every respect, a vertical engine is best adapted for this work. The question of regulation is a very serious one. The engine is undoubtedly called upon to stand a test which no belted machine has had to do on account of being directly connected to the generator, and some one of the different types of shaft governors in use on some of the standard machines seems to be best adapted thereto, and will govern within a range for this work of, say, two to three per cent.

On the question of economy so-called high-speed engines are in a measure out of date on this kind of work, as generators are reaching a size beyond the capacity of our old friend, the single valve automatic engine. This engine seems to have reached its limit in economy at about 200 to 300 HP.; that is, where controlled by a single valve. We are confined, then, to one or two types of engine. The old standard of general commercial practice, the Corliss engine, which, on account of our large experience with it, has been called upon more largely for service on this kind of work than any other, in general is meeting these requirements in most respects. There seems, though, to be some question of reasonable doubt as to whether it will regulate sufficiently close to meet the more exacting requirements of this class of work, where called upon to control very wide and sudden changes of load. On the question of economy they have shown in the past the highest economy obtainable, but that has been more especially on steady loads near their rated capacity. With loads which fluctuate as railway work does, they cannot reach nearly their guaranteed economy. We also have the disadvantage of the controlling valve when cutting off over half stroke. In Europe, where their practice on direct-connected work has extended over a much longer period than ours, they are using largely various modifications of the vertical marine type of engine, controlled by different types of governors. An engine of this class, well and substantially built, with double valves on the steam and exhaust, and controlled by shaft governor, controlling the valve up to three-quarters cut-off, would seem to combine many points of superiority for an engine on this class of work, and give service in reliability, economy and durability superior to any other type obtainable. Manfacturers and designers in this country are now rapidly developing this type of engine.

The electric railway manager says: This matter is very interesting, but where do I come out on the cost and as to economy? I will try to give him a few practical points in this regard. In general these generators are being sold to-day for about 20% above the cost of belt-driven machines of the same capacity. As we reach the larger units, which are now being built, this difference will be considerably reduced. Allowing, though, for this difference in the cost of the generator, we find, after carefully reviewing several cases in the writer's experience and that of others, that the cost of the power station complete, exclusive of real estate, but including the same electric plant and building, is not more on a direct-driven plant than the older type of belted apparatus. This should settle the question beyond doubt, especially where new stations are being built. I feel that I cannot impress you too strongly on the fact that many of the railways are going to find it to their advantage to scrap and sell at the best advantage they can their present apparatus, and build a new and modern station. The economy gain will be a large one in every respect; more reliable service; satisfaction to the public; reliance in the operation of their car service, which they have never been able to realize with their old type of small belted generators; and a reduction in station force, which will be appreciated by every dividend loving stockholder. I have tried to obtain the best and most reliable data in this question of relative economy. Most of the railway stations of the direct-connected class have only been in operation a short time. We have a number of central power stations, though, where questions of relative economy show up on a similar basis, where we have been able to obtain more reliable data. When we look around and see the present stations operating with all types of engines, connected to various sizes of generators and giving a result in economy on the horse-power output of all the way from 4 lbs. on the most reliable to 8 and 9 lbs. of coal on the medium ones, we see that there is indeed room for improvement. We have, beyond question, doubled this economy through a better, larger and more economical type of engines, operated under better and more favorable conditions, also more economical, direct-connected generators, saving in loss of belting, shafting, friction, etc. Also of a combined, direct and positive saving, bearing all the way from 10 to 50%. These figures are not theory, but are results obtained from actual practice, as is shown by data in the hands of the writer. As to whether it is going to pay to overhaul your plant as herein proposed, I will give one specific instance of the careful review of the case of a power plant of about 5,000 HP. The company has become convinced that it could build a new power plant and scrap its present apparatus; increase the fixed charges thereby $15,000 a year, and still have a net gain over their increased charges of $25,000 per annum, and in addition to this a far more reliable and better operating plant and increased capacity. I feel that we have now reached what may be termed a point of standard commercial perfection on generators for power service of all descriptions, and that the next ten years will see very little change other than the perfection of minor detals thereon, and instead of having a station operating from 20 to 40 varying types and kinds of small generators, we will have a compact and modern plant of a few large units.

THE CONSTRUCTION OF RESERVOIR EMBANKMENTS.

The recent break in the reservoir embankment at Portland, Me. (Eng. News, Aug. 17, 24 and 31), has given rise to much discussion before the Boston Society of Civil Engineers, regarding the proper construction of such embankments. In our issue of Oct. 5 we gave, under "Society Proceedings," the discussion on this subject which took place at the meeting on Sept. 30. The discussion was continued on Oct. 18, as indicated elsewhere in this issue. In response to a call from Mr. Freeman, President of the Society, for information regarding the large dams of the Boston Water-Works, Mr. Desmond Fitz Gerald presented the following paper:

The subject under discussion is naturally divided into two parts, first the proper method of laying pipes through reservoir embankments, and second the construction of the embankments themselves.

There are several ways in which pipes have failed, but they have been principally by: Laying them naked through the banks; by the improper design of the puddle around them; by subsidence and banking in the cuts of the embankment due to the great weight at that point; and by building them upon piers of masonry without continuous support.

From some study and experience in these matters I have come to the following conclusions: If pipes are to be inclosed in puddle, there should be as little as possible under the pipes, and no more in one place than another, longitudinally. If there is more, there will be unequal settlement and liability to fracture. Even under the best conditions and with ample cut-off walls, the idea of puddle in connection with a pipe has never appeared attractive to me. In the case of Dam 6 of the Boston water-works, I have placed the pipes on a continuous ledge foundation and surrounded it with brick masonry and plenty of cut-off walls. Where pipes are continued under pressure below the dam I put them in a tunnel closed by a heavy bulkhead. In this case they can be examined, and if leakage occurs the joints can be calked. By using sleeves instead of the ordinary joint any given length of pipe can be taken out without disturbing the others.

Where puddle is put in wet, and it has a chance to dry out, there must be shrinkage. I have seen striking illustrations of this in connection with reservoirs.

The experiments which I made several years ago were in connection with some observations on the evaporation from the ground. I had to fill eight large tanks with gravel, sand, earth, mixtures of puddle, and different kinds of material as ordinarily found in nature. It was necessary to cut off all percolation down the sides of the tanks, which were lined with zinc. I found in all cases where the materials were deposited in a wet condition that it was impossible to fill the tanks permanently, no matter how much ramming was done—but by ramming dry I never had any trouble from shrinkage. I remember very well after the tanks had been in use for several years, some one doubted the perfect union of the materials with the sides of the tanks, so I had holes dug and found in every case that the material brought the paint off from the zinc when it was removed, so perfect was the connection.

In regard to the best way to build earth dams, I suppose no two experts will entirely agree upon all particulars. We have, however, these great divisions of method: Homogeneous embankments; embankments with puddle or core walls in the center; and those with the puddle or concrete on the inner slope. You have already seen, from the papers that have been read, the great diversity of opinion as to the best means of construction. Like almost every other engineering work, local conditions should largely govern design, but there are certain broad pinciples which must to a certain extent control, and on the other hand there have been many disastrous failures which have taught us valuable lessons.

I agree heartily with what has been said in regard to the necessity of building up an embankment with very thin layers in order to compact the material thoroughly. In the case of Dam No. 6, of the Boston water-works, I have made the layers 4 ins. in thickness. The dams on the Boston water-works are generally built with a core-wall of concrete in the center, backed up with puddle or fine material on the water side. The wall has occasional buttresses to stop the longitudinal passage of water, and the up-stream surface is carefully plastered with Portland cement. The core-walls in some instances are nearly 100 ft. in height. The earth slopes are 2 to 1, generally, and protected in the usual manner. Four years ago I introduced a berm into the middle of a high embankment on the downstream slope with longitudinal drainage to protect the loam covering until the grass could become well rooted. I do not know of another instance in this country at that date.

The best English practice is to make the water slopes 3 to 1, and the other slopes 2 to 1, and to put the puddle walls in the center of the embankment, One of the speakers to-night said that no good reasons seem to have been given for putting the puddle in the center. I will try to mention briefly some that occur to me, though they may not be wholly satisfying.

For the same money you can put more puddle on the vertical line than you can on the inclined one. It is not exposed to the danger of slipping when the surface of the reservoir is suddenly drawn down. I am aware that this is not so liable to occur with canals as with reservoirs, but I have seen several accidents of this kind in the latter case. The water does not seem to work out of the puddle quickly enough to drain the bank, and a head results, which caves the slope. The puddle in the center of an embankment is not so exposed to frost, to drying out or to cracking as it is on the slope.

The experience of the builders of the Somskasara Canal, in India, is interesting and instructive. If I remember aright the canal is about 200 miles long and has a number of high embankments. Many leaks and washouts occurred, and these accidents led Mr. Hawkshaw to the conclusion that an embankment to retain water should be so built that even if the puddle gives out the embankment cannot be ruptured. The principle followed consised in making a filter of the section as follows: The water side half of the bank is made of any compacted material at hand; then comes a considerable thickness of fine sand, then coarse gravel, and at the lower toe of the embankment a mass of rubble. It is argued that such a section may leak but cannot give way. To make the bank tight, puddle is added on the inner slope, where it can be reached for repair. Plans have been made for embankments 200 ft. in height on this scheme, but I do not know that any have been built.

In our embankments in the Boston water-works we always place our coarsest material on the downstream side.

Mr. A. Fteley, M. Am. Soc. C. E., of New York, sent a written discussion of the subject, of which the following is an abstract:

The divergence of opinion among engineers regarding materials and construction may be owing to actual differences of material in the localities concerned, and the variations of the same material in different climates. The general principle involved is stated by the author as follows:

> The structures referred to being made to retain water, the result aimed at is to produce a mass in which the interstices will be so minute that, either through great friction the flow of water through them will be so small and so slow as to be practically insignificant, or, on account of the action of capillarity, it will be stopped entirely. To this should be added the condition that the mass will present sufficient stability.

Gravel cannot be used owing to the fact that it seldom, if ever, exists so graded in size that the larger interstices will be filled with smaller, and so on down. The author cites a dam entirely of gravel which had for 40 years retained a body of water of a maximum depth of nearly 50 ft., but at the time he inspected it there were numerous leaks at the lower toe. Where gravel is used the author is of the opinion that clay should enter into the composition of the structure, both on account of the fineness of its particles and its so-called binding qualities.

Clay, alone, or at least certain clays, are so likely to become saturated with water and to become fissured as to demand caution in their use. A number of high clay dams are reported from California, and the designer of several of them has stated that a hydraulic pressure much greater than that to which it would be subjected in a dam had not forced water through 1 cu. ft. of clay, during an experiment. This clay must have been of exceptional quality.

Wherever the available material cannot be worked into an impervious mass a water-tight lining of masonry, or of an impervious clayey mixture protected from the water by paving, is often resorted to with satisfactory results. Unless well executed with good material the clay or puddle lining may slide, or settlement of the embankment may cause a paving to crack.

At this point the author may again be quoted:

> The writer prefers, when it can be done within proper limits of economical construction, to secure water-tightness by means of an impervious wall built in or near the center of the embankment, and continuously connected with the impervious bottom, or extended downward to a safe depth. Excellent results have been obtained by puddle walls thus placed; they have the advantage of securing a perfect homogeneity with the rest of the embankment and if well executed are justified by good practice.

Owing to the difficulty of securing satisfactory work, the author prefers to use a masonry wall as a core. If a small defect occurs in such a wall only a limited amount of water can find its way out.

Mr. Fteley states further:

> I do not see that the presence of a masonry core-wall weakens the structure in which it is built, the tendency of the earth being to settle against the masonry; at any rate I have failed to find in all cases of accidents which came to my knowledge, that any was due to the presence of the wall, the cause of the failure being invariably a defect in design or construction.

Many masonry core-walls have too small a transverse section, one of concrete from a dam which failed coming to the author's notice being only 4 ins. thick. If the embankments each side of the wall be properly carried up there will be little, if any, settlement, but to guard against the effects of settlement a cross-section should be given which will resist the differences in earth pressure. This can hardly be calculated, but from practice the author gives the wall a width of about 15% the height above the point under consideration.

In forming embankments an excess of water occupies space that may remain unfilled. Satisfactory results may probably be obtained by moistening the earth to about the same degree as is observed in a deep excavation free from water.

For maintaining the part of the embankment exposed to the air, grass is the best covering, but will hardly maintain itself on a slope steeper than 2 to 1. When the height is considerable, a berm, well drained laterally, is recommended, and is considered better than a continuous slope involving the same volume of material, but with less inclination. If there is danger of improper maintenance a continuous slope is preferable.

Piping or other accessories designed to carry water to a point below the embankment is safest when placed on natural ground adjacent to the structure, and when carried through should be placed on the natural surface with only the top and sides in contact with the earthwork. When gatehouses are placed in high earth dams, in a continuation of the core wall, it is good practice to inclose the pipes in an arched masonry structure. It is necessary to surround conduits through or adjacent to embankments with collars or similar devices.

PERSONALS.

Dr. C. H. Fisher, Secretary of the Rhode Island State Board of Health, died at Buffalo, N. Y., Oct. 21, at the age of 71.

Mr. P. Ryan has been appointed Superintendent of the Kalispell Division of the Great Northern Ry., vice Mr. I. P. Welles.

Mr. C. E. Walker has been appointed Superintendent of Motive Power of the Toledo, St. Louis & Kansas City R. R., vice Mr. I. Cook, resigned.

Mr. J. Waldo, formerly Vice-President of the Missouri, Kansas & Texas Ry., has accepted the position of First Vice-President and General Manager of the Missouri Pacific Ry.

Mr. E. H. McHenry has been appointed Chief Engineer of the Northern Pacific R. R. Since Mr. Kendrick's promotion to the position of General Manager the former has retained also his title of Chief Engineer.

Gen. Roy Stone, President of the National League for Good Roads, has been appointed by the Secretary of Agriculture as Special Agent and Engineer in charge of the investigation into the road system of the United States, and the best methods of roadmaking. This appointment was provided for by the act of March 3, 1893, making a special appropriation for the purpose.

Mr. Dennis Long, of Louisville, Ky., died Oct. 8. He was born in Ireland in 1816, and came to this country in 1820. After serving his apprenticeship as a molder at Pittsburg he went to Louisville, and in a few years started a foundry and machine shop of his own, his principal business then being for the Ohio River steamers. Some of the first water pipes for Nashville, Tenn., and gaspipes for St. Louis, Mo., were made at these works. Mr. Long also, at different times, operated pipe foundries at Columbus, O., and Chicago. At the time of his death he was president of Dennis Long & Co. and of the Louisville & Jeffersonville Bridge Co. He leaves an estate valued at $1,000,000.

NEW PUBLICATIONS.

ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.—Report of Eighth Annual Meeting, held at Springfield, Ill., Jan. 25-27, 1893. 8vo; 111 pp.; cuts; $0.50.

This report, which can be had from Mr. Allen Enos, Recording Secretary, Springfield, Ill., contains the full proceedings of the Society and the papers read at the meeting named.

THE THEORY AND PRACTICE OF MODERN FRAMED STRUCTURES. Designed for the Use of Schools and for Engineers in Professional Practice. By J. B. Johnson, M. Inst. C. E., M. Am. Soc. C. E.; C. W. Bryan, Engineer Edge Moor Bridge Works, and F. E. Turneaure, Professor of Bridge Engineering, University of Wisconsin. New York: John Wiley & Sons. 4to; cloth; pp. 527; 250 cuts; $10.

This is considerably the most important addition to the literature of framed structures which has appeared in America since the publication of the enlarged edition of Prof. A. J. Du Bois' "Strains in Framed Structures," in 1890 (Eng. News, July 26, 1890). In some respects it covers much the same ground as that work, as was, of course, to be expected, since the analytics of structural design have undergone no radical change. But owing to its greater scope, especially in the description and discussion of modern tendencies and practice in designing framed structures, it can in no sense be said to duplicate the older book. Great advances have been made in the scientific and economical design of framed iron and steel structures within the last ten years, and modern methods of analysis and construction have reached something approaching a standard, except in a few particular directions. The present time is, therefore, more appropriate than any previous time during the 50 years since anything like a scientific analysis of the strains in framed structures has been attempted, for a treatise on structural design; for this is what the size and scope of the book claim it to be, and what, we believe, the authors intended it to be, although they do not say so in so many words. In some particulars we think the book falls short of what such a treatise should be, considered even within the limits to which the authors have confined the subjects treated, but on the whole such faults as we have noticed are chiefly faults of detail, and may be easily remedied. The book is quite unique in one respect. No less than ten different authors have contributed one or more chapters each to the work, each taking subjects with which they were especially familiar. The authors whose names appear on the title page have written 25 of the 29 chapters, and the remaining four chapters and three appendices have been written by seven different authors. This alone gives the work a special value.

The book is divided into two parts and 29 chapters, with three appendices covering some 30 pages. Each part will be considered separately to avoid confusion.

The first part, containing 15 chapters, discusses and explains the various analytical and graphical methods for analyizing the strains in framed structures. The general plan and scope of this part can perbaps be best given by quoting the headings of the chapters, which are as follows: I. Introductory; Fundamental Definitions—Historical Development of the Truss Idea. II. Laws of Equilibrium. III. Roof Trusses. IV. Bridge Trusses with Uniform Loads. V. Bridge Trusses with Wheel Loads. VI. Conventional Methods of Analysis. VII. Lateral Truss Systems. VIII. Beams and Continuous Girders. IX. Column Formulas. X. Combined Direct and Bending Stresses — Secondary Stresses. XI. Suspension Bridges. XII. Swing Bridges. XIII. Cantilever Bridges. XIV. Arch Bridges. XV. Deflection of Framed Structures and Distribution of Loads over Redundant Members.

The general principles of strain analysis are now so well established and so familiar that any review of the various chapters in detail is needless. In general, the endeavor of the authors has been to present these principles by simple mathematical processes, well within the easy understanding of men of ordinary mathematical ability. This is as it should be in a work intended for general use. The several methods of analysis are first presented in general terms, and then the comparative advantages and convenience of each in determining the strains in different styles of trusses is discussed.

While a detailed review of each chapter can well be omitted, two or three particular chapters contain matter, which, from its timeliness and importance, seems to demand particular notice. Among these are chapters VI., VIII. and XV. In some respects Chapter VI., "Conventional Methods of Analysis," is one of the most important and valuable chapters in the book, considering the practical importance of the subjects discussed. The recent extended discussion on the comparative advantages of calculating strains by exact and conventional moving loads makes one look with interest to see what position is taken on this subject by the authors of the book. In introducing this subject the authors say:

> If each span had to be computed but once, there would be no valid objection to the use of this exact method, which has been almost exclusively employed in America since the year 1880. It has come to be a common practice, however, to call for bids (either by the span or by the pound) under general specifications, requiring accurate "stress sheets," showing maximum loads and sizes of members, to be submitted with each bid. If, on the average, there are eight bidders, then the computations have been made independently eight times, and on the average each bidder computes eight spans for each one he succeeds in building. When the laborious method of wheel concentrations is employed, the cost of this high-priced labor becomes a considerable portion of the price named for building the bridge. In the end the purchaser pays

for the computations eight times over. At present (1892) there is a general desire on the part of the bridge companies to agree upon some conventional method of treating the train-load which will lead to easy and short computations without introducing material errors in the results. The consulting engineers who act for the railway companies are generally inclined to adhere to the more exact methods. Although any method of computing stresses from moving loads, considered as a problem in statics, comes very far short of giving the actual maximum stresses in the members, this fact does not warrant the use of an approximate and still more inexact method of solution, unless it can be shown that the results obtained are practically identical with those found by the more rigid method. It would probably be admitted by all parties that results differing by not more than 2 or 3% are practically identical in bridge computations, especially if those differences are both plus and minus, and do not appreciably change the total weight. It remains to show that convenient methods of solution can be found which satisfy this requirement for truss bridges longer than 100 ft.

Two forms of conventional train loads—(1) a uniform train load with a single concentrated load, (2) an equivalent uniform load; being a uniform load which would produce the same maximum stresses in all members as are caused by the actual wheel loads—are considered in detail and the results of computations compared with computations by wheel loads given in tabular form. The conclusions which the authors draw from this table are:

1. That the first form of loading gives better results for the web system than the equivalent uniform load. The results on the chord members are identical, since the uniform plus concentrated loading is equal to an equivalent uniform load per foot of $p + \frac{20}{l}$ for moments.

2. That the equivalent uniform load gives values very much too small for the web system when the number of panels is greater than eight. If this loading were treated rigidly for shear, the discrepancy would be much greater. This shows that if equivalent loads are used, a different equivalent must be used for shears from that which is used for moments.

3. That the uniform plus concentrated loading gives very nearly correct values for both chord and web members except for the counters, where the result is always large by from 6% in the 300-ft. span to 43% in the 150-ft. span. If this method should be employed, then the same computed fiber stress per square inch could be allowed in the counters as in the mains. When these members are rigidly computed, a liberal reduction in the working stress is made for "impact."

4. That since the facilities and aids to wheel-load computation are now so simple and efficient, and since this is acknowledged to most nearly represent the actual conditions of service, such loads should continue to be used in the actual dimensioning of both truss and plate girder simple span bridges when they are prescribed in the specifications.

5. That for estimating cross-sections and weights of bridges for the purpose of bidding on work, the first mentioned form of conventional loading might well be employed. The total weight found from its use would probably not differ by more than 0.1% or 0.2% from those found from the rigid method. The final sections however, should be fixed by the wheel-load method of computation.

Chapter VIII., "Beams and Continuous Girders," contains a very clear exposition of the fundamental relations in the theory of beams, and is prefaced by a concise historical sketch of the development of the theory and its treatment by different writers, which is by no means the least interesting portion of the chapter. The larger part of Chapter XV., "Deflection of Framed Structures and Distribution of Loads Over Redundant Members," has been before the public since 1890, it being an adaptation of a paper read before the Engineers' Club of St. Louis, by Professor Johnson.

Part II. of the book treats of the general and detailed design of framed structures, and is divided into 14 chapters, all but three of which are devoted to the design of bridges and viaducts. The general considerations affecting the selection of the proper style of bridge for various conditions are stated, and the comparative advantages and limitations of plate girder and riveted and pin connected truss spans discussed. In some particulars this chapter is disappointing. For example, in discussing bridge floors we find the very general and superficial statement that solid iron and ballast floors are more expensive than the usual stringer and cross-tie floor. Such a statement as this is absolutely of no value. Any tyro can perceive that this must be so. What should have been done, and easily could have been done, would have been to give the comparative cost of the two styles of floors as ordinarily built, with some statement as to their comparative durability, safety in case of derailment, effect on the riding of the train, etc. The reader would then have had the facts upon which to base a judgment as to the advisability of using one floor or the other in any future work. As it is he has to go somewhere else for this information. We mention this point because it is a good example of a common fault in text-books on engineering construction.

The next two chapters, XVII. and XVIII., on the design of individual truss members, and the details of construction, are especially good in practical examples and illustrations of current practice. Chapters XIX. to XXIV., inclusive, take up in detail the designing of plate girder and truss spans, roof trusses, swing bridges, and Howe truss bridges, and give for each case a completely worked out example from the calculation of the strain sheet to the completed structure. These chapters should prove especially useful to the student and young engineer.

Chapter XXV. discusses timber and iron trestles and elevated railways. The section on elevated railways contains a large amount of matter not found in former text-books. Well illustrated examples of elevated structures in New York, Brooklyn, Philadelphia, Chicago and St. Louis are given, and the general considerations of longitudinal and lateral stability, economic span length, column flexure, and cost are discussed. The increasing demand on engineers for designs for this class of structure makes this chapter of great value. In the same connection may be mentioned the chapters on stand-pipe and elevated tank construction, mill building construction, and iron and steel tall building construction, the last by Mr. C. T. Purdy, whose series of articles on the same subject in back volumes of Engineering News (Dec. 5, 12, 26, 1891; Jan. 2, 1892) will be remembered. The chapter on Mill Building Construction is adapted by Mr. George H. Hutchinson, from his paper on that subject read before the Engineers' Society of Western Pennsylvania (Engineering News, Nov. 10, 1892). These two chapters treat of a practically new field in structural engineering, and are written by men well qualified by practical experience to deal with the subjects discussed.

In the chapter on "The Aesthetic Design of Bridges" (XXVI.), the authors have entered a field hitherto almost entirely neglected by writers on bridge design and construction. With a few notable exceptions, American bridges, both highway and railway, show an almost entire neglect of aesthetic considerations in their design. This is due partly to the inherent difficulty of the subject and partly to the uneducated artistic tastes of the people. The scope of the chapter is pretty well indicated by the headings under which the subject is considered which are as follows: Hindrances to Aesthetic Design—Fundamental Principles—Influence of Building Material, Color and Shades and Shadows on the Appearance of a Bridge—Ornamentation—Aesthetic Design—Substructure—Superstructure—Roadway—Railings. The chapter is illustrated by 15 pages and three two-page plates, showing details of bridges, designs for railings, portals, cornices, etc., and half-tone engravings of 18 different bridges in this and European countries. A brief critical discussion of each of the plates is given.

The publishers' work on the book is on the whole quite satisfactory. In general the cuts are good and fairly well printed except in a few cases. There is a tendency toward padding by the use of full page plates where a cut in the text would have served as well, but these cases are comparatively few. A fairly good index accompanies the book.

SOCIETY PROCEEDINGS.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Oct. 18 a paper on "Landslides and Their Prevention," as illustrated in some noted examples on the German government railways, by D. A. Moliter, was read by Professor Johnson. The paper discussed the various causes of landslides in cuts and on embankments, in different kinds of soils, and gave the details of many noted cases, and the methods used to stop them, all illustrated with full plates. It also presented a new theory of equilibrium of earth slopes and pressures against retaining walls.

Arthur Thacher, Secy.

LIVERPOOL ENGINEERING SOCIETY.—The opening meeting of the twentieth session of this society was held Oct. 25, when the new president, Mr. H. Percy Boulnois, delivered his inaugural address. At the succeeding fortnightly meetings for the remainder of the present year the following are the papers intended to be read: Nov. 8, "Some English Waterways," Mr. J. A. Saner; Nov. 22, "The Adjustment of Surveying Instruments," Mr. Ivan C. Barling; Dec. 6, "Water Saving Machinery," Mr. F. M. Evanson; Dec. 20, "A Tour in South Africa," Mr. G. L. Burton.

R. C. F. Annett, Secy.

MICHIGAN ENGINEERING SOCIETY.—The annual meeting of the board of directors was held at Jackson, Mich., Oct. 20, and letter ballots were canvassed and the following officers declared elected for the coming year: President, E. W. Muenscher, Manistee; Vice-President, Geo. S. Pierson, Kalamazoo; Secretary and Treasurer, F. Hodgman, Climax; Directors, J. J. Granville, Saginaw; Door Skeels, Grand Rapids; J. B. Davis, Ann Arbor. Arrangements were made to hold the next annual convention at Jackson on Jan. 2, 3 and 4, 1894.

F. Hodgman, Secy.

BOSTON SOCIETY OF CIVIL ENGINEERS.—On Oct. 18 a number of members of the society visited the sewerage system of Brockton, Mass., now under construction, including the intermittent filtration area for the purification of the sewage, described in our issue of Oct. 5. In the evening the discussion of "The Construction of Reservoir Embankments" was continued from the meeting of Oct. 30. Written discussions were submitted from Mr. A. Fteley, M. Am. Soc. C. E., and Mr. Edw. Smith. Mr. Desmond Fitz Gerald, M. Am. Soc. C. E., made some remarks on the subject, which are given elsewhere in this issue as is an abstract of Mr. Fteley's communication.

INTERNATIONAL ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.—At the annual convention held in Philadelphia last week the committee on "Turntables" presented a report in which they referred to the necessity of securing good foundations, and approved of carrying the masonry high enough to have the circular rail laid directly upon it. As to the centers, those with ball bearings and those with spiders, bevel rings and conical rollers of cast iron were both said to be giving satisfaction. The committee on "Guard Rails" reported a preference for a size of 8 × 8 ins. or 10 × 10 ins. and favored facing them with angle iron or iron straps, especially where the common size of 6 × 8 ins. is used. Reference was made to the use of inside guard rails consisting of T rails laid on their sides, with the flanges 8 ins. from the track rails. These guards are brought together on the approach. This arrangement is used on the Elgin, Joliet & Eastern R. R. in conjunction with wooden guard rails on the ends of the ties. The committee on "Water Columns" mentioned the Sheffield, Dodge, Mansfield and Poage columns as good devices. Other reports were presented on "Platforms" and "Elevating Track on Bridges and Trestles." The list of officers elected was published last week.

ENGINEERS' CLUB OF CINCINNATI.—At the September meeting, Col. Latham Anderson read a paper entitled "Telford Versus Macadam—Which Was Right?" in which he discussed the question of the best method of constructing broken stone roadways. The essential feature of a roadway of this kind, he said, were: An unyielding foundation, thorough surface and under drainage, hard tough stone for wearing surface, proper size of stone, and the thorough compacting of the materials. The paper discussed two of these requirements: the foundation and the covering, as contained in the practice of Telford and Macadam. The most important thing in connection with the foundation was the proper and thorough drainage of the subsoil by lines of tile drains, 2½ ins. to 3 ins. diameter, more or less in number according to the width of the roadway to be built, completely carrying off all the water and rendering the soil at all times dry and hard. A foundation of broken stone 10 ins. in depth on such a bed would carry the heaviest load that could come upon it in ordinary practice. The stone for the top surface should be clean, crushed in a mechanical crusher and screened in a revolving cylindrical screen through ¼, ¾ and 2-in. holes, the dirt and dust being rejected. The subgrade should first be covered with a layer of 2½ to 3 ins. of screened gravel. On this is spread and lightly rolled 6 ins. of the coarser sizes of the stone, and on this the fine layer is spread and thoroughly rolled, about 2½ ins. in thickness. A moderate amount of sprinkling assists in consolidating the materials.

J. F. Wilson, Secy.

ENGINEERING ASSOCIATION OF THE SOUTH.—At the regular meeting in Nashville, Tenn., Oct. 12, Prof. Wm. W. Carson, of Knoxville, Tenn., presented a paper entitled "A Plea for a More Rational Presentation of the Calculus." The beginner in calculus finds the continuity of mathematical science broken, and, instead of meeting the characteristic clearness of proof, he is surrounded with perplexity and darkness. The author investigates the cause of this state of things and proposes a remedy. The demonstration of the calculus of to-day rests on limits or infinitesimals, or on both. The former proves the formulas, without giving any foundation or explanation of the nature of the calculus; the latter explains, but does not prove; yet, as it leads directly to correct results, it is accepted. Proofs by limits, when sifted down, rest on slippery definitions and ambiguous language; infinitesimals are invested with the property of having magnitude that is considerable or not, as may be most convenient. The author repudiates the doctrine of infinite quantities, both infinitely great and infinitely small; such a classification is artificial and useless. The equations of the infinitesimal calculus are false to him who understands the dx's and dy's to stand for infinitesimal increments, though true to him who understand them to stand for something else, and it is by performing the operations of the latter's conception that true results are obtained. Instead, the author would introduce hypothetical quantities. A real occurrence takes place by a continuous change of conditions, and in a real magnitude the conditions are different for its different parts; the hypothetical quantity is what we suppose would exist under a reduced number of conditions actually obtaining in the real quantity, hence is simpler than the real. The calculus is defined as "that branch of mathematics which connects real and hypothetical quantities." The problem of the differential calculus is, given the real quantity to find the hypothetical; that of the integral calculus is, given the hypothetical to find the real. The investigator desires to find a certain real magnitude, which, by reason of the complexity of the conditions, is beyond the reach of his other mathematics; he turns to the hypothetical and considers a magnitude similar in nature to the real, and that would exist if the conditions were less complex; if this simpler magnitude is within the reach of his mathematics, he passes by the rules of integration to the real; otherwise the process of the hypothetical is repeated until the conditions are sufficiently simple, then, by a sufficient number of integrations, the real is reached. With this conception of hypothetical quantities are logically derived the equations gotten by the limit calculus, and what its "derivatives" really are is shown; multiplying these equations through by dx gives the equations used in the infinitesimal calculus.

The association will next convene at the annual meeting, Nashville, Nov. 9.

Walter G. Kirkpatrick, Secy.

AMERICAN STREET RAILWAY ASSOCIATION.—The twelfth annual meeting was held in the Assembly Hall of the Milwaukee Industrial Exposition Building, Milwaukee, Wis., Oct. 18 to 20, 1893. The president, Mr. Longstreet, called the meeting to order and introduced the mayor of Milwaukee, Mr. John C. Koch, who addressed the meeting. The president then delivered his address, from which we make the following extract:

> This has been a busy year in the great work of consolidation, reorganization and active progression; the financial cloud which has hung threateningly for so many months over every industry in our land has had its retarding effect upon our particular industry, but perhaps it has affected our business in a lesser degree than any other branch of business employing so large a capital. The hundreds of millions of dollars interested in urban and suburban transportation will always be a safe investment; if, in our enthusiasm, we have sometimes over-discounted the future, we have only to wait a little longer period for the dividends which are sure to come. Financial panics through which we are now passing are of irregular occurrence, yet they are sure to reappear, affecting receipts and making economies of management a subject of deep study.
>
> In my experience, covering a period of nearly 30 years, I have found it better to keep up the quality of service at such times, even at the expense of dividends for the time being; the public, by a more liberal patronage, will eventually more than make up the loss which would follow on the heels of a reduced and debased service; the faithful employee and the roadbed and equipment should be the last to suffer. Economies should begin in the purchase of supplies, in better methods of work and in improved appliances, aiming always for the best service at the least possible cost; and that is why, in just such times as we are now passing through, we should see if some plan cannot be devised which will increase the usefulness of our association. One such plan was proposed by me a year ago, and was referred to the Executive Committee. After a careful consideration of the matter the committee decided to give an object lesson of that plan at this time, and therefore arrange for an exhibition on a grand scale of all the appliances used in our business. While the unusual financial stringency and the special exhibit at the Columbian Exposition have served to detract very much from the completeness which we had hoped for this exhibition, yet it will be sufficient as an indication as to what might be expected from a continuous exhibition of the kind.

The report of the Executive Committee was read by the Secretary, Mr. Wm. J. Richardson, and it showed that, after numerous consolidations among members, the present membership is 200 companies. The committee considered at some length the formation of the American Street Railway Industrial Institute, and submitted a proposed act of incorporation, but stated that while the committee has had under consideration, more or less, the subject of the formation of this institute, it believed the time has not yet arrived to do more than commend to all the serious consideration of this important question, and, therefore, requested that the subject be continued with the committee for another year, and referred to the exhibits made at the meeting as suggesting, in a small way, what a permanent exposition would be in the display of the manufactured articles for the street railway business.

The first paper read was on "Power House Engines," of which an abstract is given in another column, and at the Wednesday evening session Mr. O. T. Crosby made some remarks on the relative condition of the power required in the engine and generator of electric railway power plants.

The next paper read was the report of the Committee on Heating and Lighting of Street Railway Cars. The report of the Committee on Standards was called for, but Mr. O. T. Crosby, chairman of the committee, reported that no written report had been prepared and the committee was continued another year. The next report called for was that of the Committee on "Can the T-Rail be Satisfactorily Used in Paved Streets?" but a letter from Mr. C. Densmore Wyman was read, in which he regretted his inability to prepare a report, owing to the demands of other duties, and the president then requested a discussion of the subject by the meeting, which we shall give later. The appointment of a committee on "A Standard Rail of Street Railways" was referred to the Executive Committee.

At the Thursday morning session the first business was the reading of a paper on "Storage Batteries in Connection with Central Stations for Utilizing Surplus Energy for Lighting or Power," which was followed by a paper by Mr. Elmer E. Sperry, describing some experiments in traction with coupled and independent axles. These two papers we postpone to our next issue. The other papers of interest to our readers we publish in full or in abstract this week.

Mr. Payne, of Milwaukee, announced that the Bell Telephone Co. extended an invitation to the delegates to visit its exhibit at the World's Fair. Mr. Payne said he had no doubt it would be a great benefit to all to know more about the intricacies of the very delicate instrument, the telephone. The telephone system and the street railway system do not always get on very well together unless they are properly built; and no doubt it would be to the mutual advantage of all concerned if they should become better acquainted, each with the other, as to the methods of construction of telephone lines as well as of street railways and their operation.

At the Thursday afternoon session the first paper read was on "Direct Driven Generators," which was followed by one on "Magnetic Cut-Outs," by Mr. W. E. Harrington, of Camden.

Mr. Payne, the newly elected president, made an address, and Atlanta, Ga., was selected for the next meeting.

Officers were elected as follows: President, Henry C. Payne, Milwaukee; First Vice-President, W. J. Stevens, Washington; Second Vice-President, J. A. Chapman, Grand Rapids, Mich.; Third Vice-President, Louis Perrins, Trenton, N. J.; Secretary and Treasurer, W. J. Richardson, Brooklyn, N. Y.; Executive Committee, E. F. Longstreet, Denver; T. H. McLean, Indianapolis; Edward Whittaker, St. Louis; W. J. Soper, Ottawa, Ont.; E. S. Goodrich, Hartford, Conn.

INTERNATIONAL IRRIGATION CONGRESS.—This Congress was held at Los Angeles, Cal., Oct. 10 to 14, inclusive, with many American and a few foreign delegates present. A large number of papers on a variety of topics were read. Much of the time of the congress was taken up with the policy which ought, in the opinion of the delegates, to be pursued by Congress in regard to irrigation and the cession of the arid lands to the several states in which they are located. After much heated discussion, a platform opposed to such cession was adopted. Some comments on the manner in which the business of the congress was conducted, the sentiments expressed and the platform adopted are given by a correspondent in another column.

Mr. F. H. Newell, of Washington, D. C., outlined the irrigation investigations made by the Interior Department, or more specifically the U. S. Geological Survey, and stated that with present methods there is not sufficient water for the land awaiting reclamation. Major Powell, Director of the Survey, took the same ground, and used it as a basis, or partial basis, for arguing that the arid lands should not be ceded to the states.

Don Jose Ramon Ibarrola, the delegate from Mexico, spoke of the importance of the Rio Grande and Colorado rivers to irrigation. He also presented a paper on irrigation in the valley of the Rio Grande and in Mexico as a whole.

A paper by Mr. Charles M. Irish is sufficiently outlined by its lengthy title, as follows: "The Need of Unity of Action on the Part of the Practical Irrigators of the Arid Region, and the Necessity for Compiling and Publishing the Methods of Irrigation and Cultivation of the Crops Raised by Them in the Arid Regions." Mr. J. W. Gregory, of Kansas, presented a paper on "The Significance of Irrigation as Regards the Great Plain Regions of the United States." Windmills and pumps are being used to irrigate portions of the plains. "Irrigation as Applied to Horticulture" was discussed by Dr. Joseph Jarvis, of Riverside, Cal., and the old and new methods in Southern California outlined.

"Sun Heat as a Source of Power for Irrigation Purposes" was the title of a paper by Mr. L. W. Allingham, who described a machine of his own invention for this purpose. Count Comodzinsky, of Russia, spoke a few words in his native tongue, after which there was read a translation of a paper by him describing irrigation and drainage in Russia, and the use of sewage in connecton wth horticulture. "Some Mistakes in the Development of Irrigation Enterprises" were pointed out by Mr. C. R. Rockwood, reference being had to the commercial aspects of the subject. The same author also read a paper on "Irrigation Below Sea Level," in which he discussed and approved of the proposed irrigation of the Colorado desert from the Colorado River. Mr. S. M. Woodbridge, of Los Angeles, read a paper on the "Relation of Irrigation to Fertilization," in which he outlined the different methods of applying water to land, and discussed the necessity of using the right amount of water.

"Irrigation Legislation" was presented by Mr. C. C. Wright, of California, the author of the Wright Irrigation District Law, who discussed the law and its operations. Col. R. J. Hinton, of New York, read a paper on the "Nation's Relations to the Irrigation Problem and Water Management," in which he opposed cession of the arid lands to the states and favored governmental conservation and regulation of water supplies. The great Colorado canyon, from an engineering standpoint, was described during the congress by Mr. Robert Stanton, M. Am. Soc. C. E.; and Mr. Gustav Laveaux, of Los Angeles, discussed the "Relations of Forestry to Irrigation," urging that a school of forestry be established. A brief paper by Mr. Leon Phillipe, of France, described irrigation in Fance. "Irrigation and Its Effects on Civilization" was presented by Mr. C. W. Cross, of San Francisco, who characterized irrigation as the friend of good government; by increasing the density of population it promotes intellectual advancement. The progress of irrigation in the Mojave desert and in Death Valley was described by Mr. C. Mulholland. Mr. A. P. Davis, of Los Angeles, presented a paper on the "Economy of Water," in which he advocated State action for the storage of water at high elevations and the construction of irrigation works by the government.

The platform, or address of the congress to the people of the United States, has already been referred to. Aside from opposing cession of the arid lands to the states it outlines the character of the land now remaining in the public domain, and calls attention to the fact that the government has left practically no arable lands, but a vast amount of land that might be made so by irrigation, and urges that a wise policy be adopted regarding the future management of these lands, and especially of the waters. The Wright irrigation law is commended, and also exhaustive investigations of all the questions involved with a view to gathering information for future legislation.

Mr. F. L. Allis, of Los Angeles, Cal., was secretary of the congress. It is reported that the proceedings will be printed in full at an early date.

COMING TECHNICAL MEETINGS.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Oct. 27, 28. Secy., L. J. Carmalt, Roanoke, Va.
ENGINEERS' CLUB OF ST. LOUIS.
Nov. 1. Secy., Arthur Thacher, Odd Fellows' Building.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Nov. 1. Secy., F. Collingwood, 127 East 23d St., New York.
ENGINEERS' CLUB OF PHILADELPHIA.
Nov. 4. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
Nov. 4. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago Secy., John Ericson.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Nov. 6. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Nov. 7. Secy., W. Halliburton.
WESTERN SOCIETY OF ENGINEERS.
Nov. 8. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
Nov. 9. Secy., E. Nexsen, 504 Kasota Block.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Nov. 9. Secy., C. H. McLeod, Montreal, P. Q.
ENGINEERING ASSOCIATION OF THE SOUTH.
Nov. 9. Secy., W. G. Kirkpatrick, Nashville, Tenn.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Nov. 9. Secy., F. W. Mowbray, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Nov. 10. Secy., D. W. Meeker, St. Paul.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Nov. 10. Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Nov. 10. Secy., O. Von Geldern, 719 Market St., San Francisco.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Nov. 11. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
Nov. 13. Secy., Waterman Stone, Baird Building.
DENVER SOCIETY OF CIVIL ENGINEERS.
Nov. 13. Secy., F. E. King, Jacobson Block.
WISCONSIN POLYTECHNIC SOCIETY.
Nov. 13. Secy., M. F. Schinke, City Hall.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Nov. 14. Secy., F. C. Osborn, Case Library Bldg.
NORTHWEST RAILROAD CLUB.
Nov. 14. Secy., W. D. Crosman. Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Nov. 14. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Nov. 15. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Nov. 15. Secy. F. M. Curtis, O. C. R. R., Boston.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Nov. 15. Secy., S. E. Tinkham, 36 Broomfield St.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Nov. 15. Secy., L. V. Carmalt, Roanoke, Va.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 16. Secy., S. A. Charpiot, Macon, Ga.
NEW YORK RAILROAD CLUB.
Nov. 16. Annual meeting. Secy., John A. Hill, Temple Court, New York
ENGINEERS' CLUB OF CINCINNATI.
Nov. 16. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Nov. 16. Secy., Allen Strale, 100 Washington St.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Nov. 17. 201 Washington Building.
WESTERN RAILWAY CLUB.
Nov. 21. Secy., Clement F. Street, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
Nov. 21. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Nov. 21. Secy., R. H. Clark, Pittsburg.
CENTRAL RAILWAY CLUB.
Nov. 22. Secy., S. W. Spear, Buffalo, N. Y.

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The date when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance. No other receipt is sent unless requested.

ADVERTISING RATES: 20 *cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.*

Several papers have lately repeated editorially a Washington rumor that a serious difficulty has arisen in drilling and fitting the Harveyed steel armor plates, owing to the excessive hardness of the material. The editors go on to say that this difficulty may lead to the less general use of the new process as softening the area to be treated by gas jets greatly increases the already very high original cost of the plate. It is to be feared that the writers have not studied very closely the purpose and method of the Harvey process. In the first place, the underlying principle of this process is the creation of a supercarbonized and very hard surface intimately united with a tough backing of a comparatively low grade steel; the purpose being to crush the projectile into fragments on the surface and before it can enter the tough backing which is there to prevent or decrease through cracking. In a 10½-in. plate this hardening treatment penetrates about 3 ins., leaving the remainder of the plate practically unchanged. As modern armor plate is very thick, it is possible, and this is the general practice, to make all attachments to the back of the plate, and the work is thus done in a comparatively easily worked material. As to fitting the plates in place, all heavy shaping can be done before the plate is treated at all, this treatment being a finishing process. While it can well be imagined that any tooling found necessary on the front edges of a Harveyed plate is very expensive work, we do not believe that the case presents the serious difficulties to our ordnance officers that our contemporaries imagine. The practical effect of this surface hardening of the plates is shown in the late trials at Indian Head proving ground. With an initial velocity of about 2,000 ft.-secs., an 8-in. projectile will penetrate about 6 ins. into a 12½-in. plate; with the general result that the point of the projectile is broken off and is welded to the plate by the excessive heat generated on impact, while the remainder of the shell is broken into fragments and the tough steel backing prevents all cracking.

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Another frightful disaster, this week at Battle Creek, Mich., and several minor ones, have continued this summer's appalling list of accidents directly traceable to reliance on human memory only for the movement of trains, unaccompanied by any mechanical check thereon. As usual, "the railway officials say that, outside of the legal proceedings, they will hold an independent and searching inquiry into the cause of the calamity, with the view of placing the blame where it belongs." As usual, there was a seemingly unaccountable misunderstanding and neglect to read orders or remember them by old employees heretofore careful and trustworthy. As usual, the daily press sees only the "direct disobedience of orders," and does more harm than good by overlooking the real difficulty, and indulging instead in scathing denunciactions of the guilty employees as individuals, and of the management for its "slack discipline," and of the penalties enforced for forgetfulness; quite oblivious of the fact which experience has long since established, that no possible discipline and no possible care and caution in the individual will prevent occasional lapses of memory and attention in critical moments which the individual himself cannot account for afterward, and which are more likely than not to occur at the very moment when there is least call for and most risk from them. A striking instance which we have often referred to as within the present writer's personal experience was that of a well-trained and cool-headed official who was acting as switchman during a strike, and who watched a train slowly approaching across a long bridge with his switch set right, but almost at the moment that the engine reached it was seized with an illusion that the switch was wrong, threw it over, and derailed the train! Every honest and intelligent man knows that if he were doing every day from hour to hour acts which must be done just so or death and destruction would result, he would be extremely likely to be confused or forgetful sooner or later, after years of service.

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Because of these facts, which experience has abundantly established, it was long since recognized that nothing but machinery could never forget, and machinery to guard against forgetfulness was long since invented, put into use, and is now universal in Great Britain and nearly so on the Continent. It is not absolutely infallible in its action, simply because it has to act in some degree through human perceptions, but it is so nearly so that compared with present conditions on roads without an absolute block system it may be called infallible. We could wish that the daily press would recognize and comprehend these facts, and when accidents occur because of them would lay the blame to its true cause, and so help on reform, instead of making themselves ridiculous by denouncing human beings for having merely human minds and nerves, which never have been, never can be and never will be perfect and infallible in their action.

Editors of the daily press seem to take a surprisingly long time to realize the fact that, though the penalty for any forgetfulness were death upon the rack, or any other frightful penalty that may be imagined, and though men saw this penalty continually inflicted and knew it to be certain, and though the discipline of the road were more rigid and continuous than in any army or any prison, and had the law behind it to enforce it—men would still forget! They might not do it very often nor for very long; they do not now; but they would do it often enough and long enough to cause accident; and in all human probability the severity of the penalties and discipline, instead of helping men to remember, would help them to forget, by increasing the tendency to mental confusion. Our trainmen do about all that it is in human nature to do now. It is only once in many thousand times that they forget; and the only possible remedy for that degree of forgetfulness is to use machines, which cannot possibly forget.

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The rear collision at Jackson, Mich., on the Michigan Central, of which we gave some account last week, has been very carefully investigated by a coroner's jury. The important facts brought out in the investigation are as follows: The engineer of the second section, which ran into the rear of the head section while it was standing at the station in Jackson, was a freight engineer, temporarily promoted to passenger service. He took the train at Detroit and made the run to Jackson, 76 miles, stopping at Wayne, Ypsilanti, Ann Arbor and other points, at all of which the air-brakes worked perfectly. The last stop before reaching Jackson was made at a water station 13 miles east, and here the brakes held so well as to stop the train short of the tank. From here to Jackson the run was made at an average speed of 61 miles per hour, and as the yards were entered at Jackson the brakes were again applied and the speed was slowed to about 25 miles per hour, the brakes again working perfectly.

The standing train was protected by a semaphore 470 ft. from the rear car. Near this was a switch which connected to a track leading to the other side of the station. The engineer had a clear view of the semaphore and of the standing train when he was over half a mile away. He claims that when he applied the air-brake to bring his train to a stop, the brake went on the engine but not on the train, and he called for hand brakes. The conductor claims that in response to this call he opened the conductor's valve in one car, and as no air escaped he ran into another car and opened the valve there, but with the same result. About half an hour after the collision, an inspector of the road examined the brake equipment and found the angle cock closed between the tender and the first car. Certain witnesses testify that a man leaped from the front platform of the baggage car while the train was running through the yards, and there is a theory that it was a tramp, who closed the trainpipe cock, supposing that by so doing he would stop the train and give himself an opportunity to jump off. Other witnesses testify that they watched the train and no one jumped from this platform.

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The most reliable piece of evidence as to the action of the brakes is the fact that after the accident the brakes were found applied throughout the train, and had to be bled before the cars could be moved. This proves conclusively that there was air pressure on the train, although it may have been weakened by repeated applications of the brakes when first entering the yards, and also proves with almost equal certainty that the brakes were applied by either the engineer or the conductor, for the shock of the collision, we understand, did not injure this train sufficiently to break the trainpipe or its connections. If the conductor's statement is true that he opened the valves and no air escaped, then it must have been because the air was already out of the trainpipe, having been let out by the engineer in making the emergency application. In this case the trainpipe cock at the rear of the tender must have been closed by some person during the half hour following the collision before an examination was made.

It seems most probable that the engineer wasted his air by repeated applications of the brakes when first entering the yards, and so had too low pressure in his reservoirs to make the brakes hold well when the final application was made. This final application he delayed too long in making, and he may have been honestly deceived into the belief that the brakes did not apply on the cars on account of the fact that they acted feebly by reason of the reduced pressure. There is also a theory that the engineer kept on, without slacking speed, expecting to find a switch thrown in the rear of the standing train to turn his own train to the other side of the station where his passengers could breakfast. When he saw the switch was set for the straight track, it was too late to stop before striking the train ahead.

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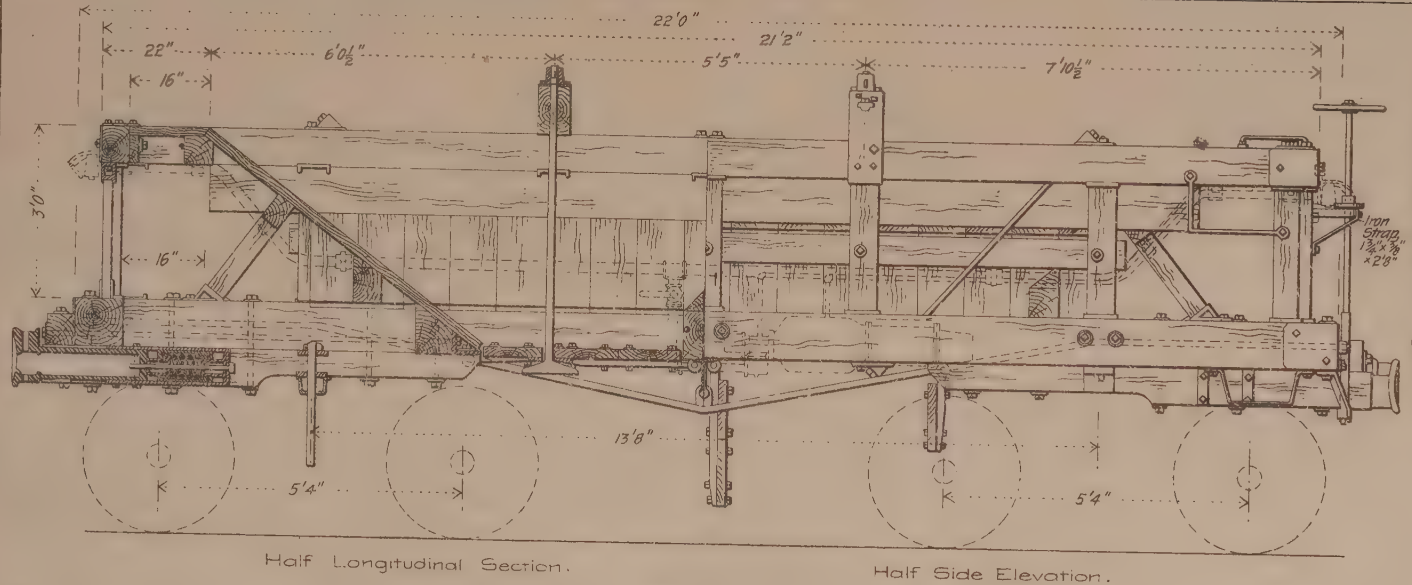
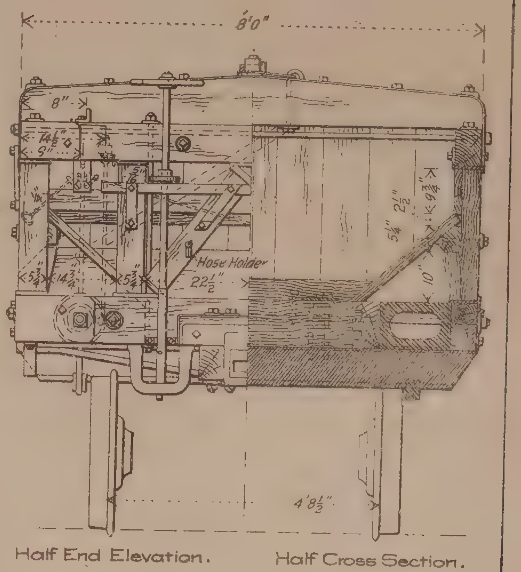
The steady absorption of the more important minor railway lines by the great systems goes steadily on and bids fair in a very few years to place the control of the great bulk of the country's railway lines in the hands of a dozen or so great corporations. The latest important move in this direction is the purchase this week of a controlling interest in the valuable property of the Delaware, Lackawanna & Western R. R. Co. by the Vanderbilts. By this deal, which is stated to be an outright purchase of a majority of the company's stock, the Vanderbilts add 899 miles of line to their system east of Buffalo, and secure one of the best paying railway properties in the country. Aside from the value of the property as an investment, there are other considerations which make the road a desirable property for the purchasers. Its independent stand, especially in regard to the coal traffic, has often been a disturbing influence in the Trunk Line Traffic Association, and its consolidation with the Vanderbilt lines places the several



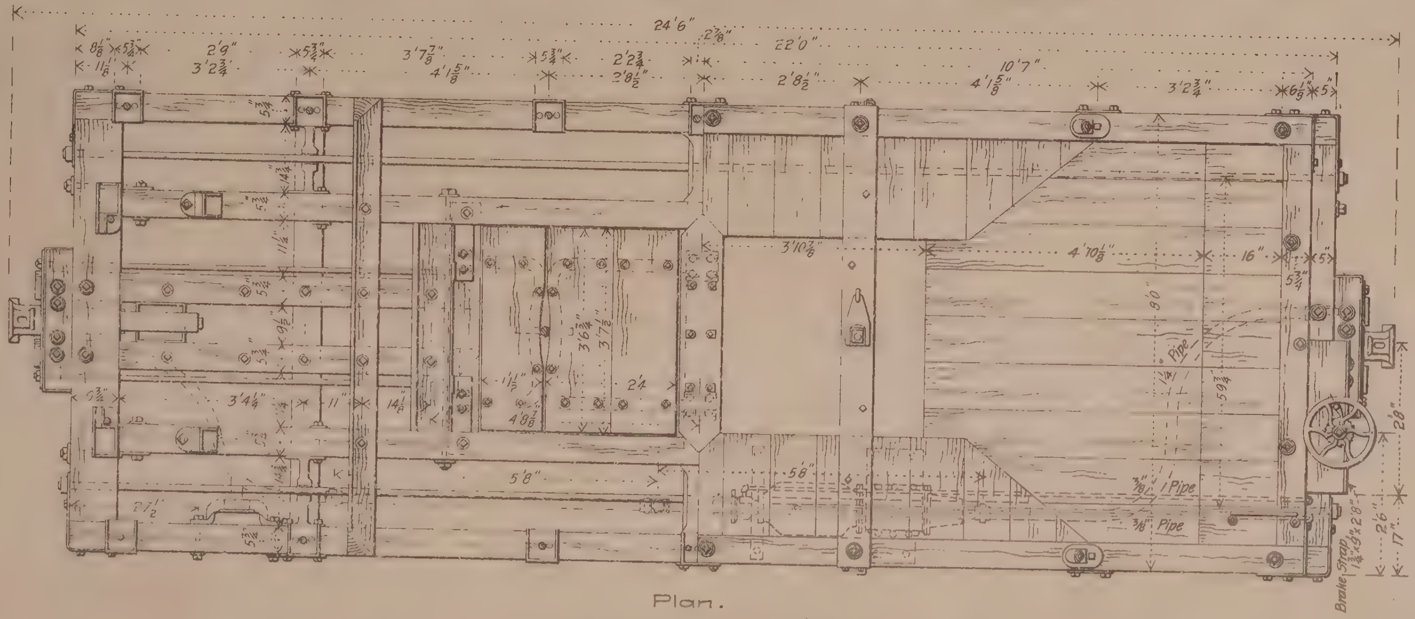
Half Longitudinal Section.

Half Side Elevation.



Half End Elevation.

Half Cross Section.



Plan.

Standard Ore Car; 24 Tons Capacity; Duluth & Iron Range R. R.

H. S. Bryan, Master Mechanic.

BILL OF LUMBER.

Pieces.	No. of pieces.	Thickness, ins.	Width, ins.	Length, ft.	Length, ins.
Intermediate Sills,	2	5¾	9¾	20	8⅛
Draft "	4	5¾	9¾	5	5⅝
End "	2	9¾	9¾	7	4⅛
Center Cross Beam,	1	9	9¾	8	11⅛
" " " Cap,	1	4½	9	4	6
Cross Timb., Hopper Ends,	2	7¾	9¾	8	11⅛
Draw Timbers,	4	5¾	7¾	7	9
Buffer Blocks.	2	5¾	7	2	6
Cross Beam on Sills,	2	5¾	9¾	8	0
Upper Cross Beam,	2	7	10	8	0
End Posts,	4	3¾	5¾	2	3
Corner "	4	3¾	5¾	2	3
Center "	2	3¾	5¾	2	3
Side "	8	3¾	5¾	2	3
End Braces,	4	1¾	4¾	2	6¼
Side Bearing Timbers,	2	4	5½	14	3
Supports for Same,	10	4	5¾	0	9⅝
Side Hopper Plank,	2	1¾	9¾	17	8
Bench Caps,	2	4	5¾	7	0⅛
" " Posts,	4	4	4	0	21
Side Hopper Plank,	34	1¾	9¾	2	4
End " "	10	1¾	9¾	6	0
" " "	4	1¾	9¾	4	10
" " "	4	1¾	8	3	6
Deck Planks,	14	1¾	9¾	1	4
" "	4	1¾	8	1	4
Drop Door Planks,	4	1¾	14	3	6¾
" " "	2	1¾	13½	3	6¾
Brake Step,	1	1¾	9	2	8
Side Sills,*	2	5¾	9¾	22	0
" Rail,*	2	5¾	7¾	21	2
End " *	2	5¾	7¾	7	4
Deck Beams,*	2	5¾	6	7	4½
" "	2	1¾	4	7	⅛
Addition to Corner Posts,	4	1¾	5¾	2	3

Sizes given are of finished lumber. Lengths are exact with allowance for tenons. All pieces of white oak, except those marked *, which are of Norway pine.

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anthracite coal lines in harmony with each other. Again, the purchase is in line with the policy of the Vanderbilts to secure control of all the important railway lines in New York state. Just what change of policy will follow the property's transfer cannot be stated at present. The purchasers, however, disclaim any intention of combining to control the anthracite coal traffic. In many respects the deal would seem to act as a favorable influence upon the trunk line railway situation.

THE SOARING POWER OF BIRDS.

We publish in another column a letter from Prof. I. P. Church, of Cornell University, asking some questions and expressing some doubts in regard to the paper and editorial on the above subject published Oct. 12 (best stated perhaps in his third and fourth paragraphs), to answer which properly takes rather more space than is proper for a mere foot note.

The point raised by Professor Church is one which puzzled the author of the paper not a little until he saw the true nature and the unreality of the supposed difficulty, which is by no means easy to see, because all questions connected with the mechanics of flight are entirely beyond the range of our every-day experience with physical laws. We hope to show, however, that the certainly plausible and apparently sound reasoning of our correspondent must in fact be erroneous, and to point out where the error lies.

Suppose a boat moving at 20 miles per hour, having on its deck an inclined plane dipping forward 13.38 ft. high. Let a spherical or other rolling weight roll down this plane. At the foot thereof it will be moving at 20 miles per hour relatively to the boat, and hence (necessarily) at 40 miles per hour relatively to the earth. It then has and must have just four times the energy stored in it that it had in the beginning, one part of which is its original moving energy, one part that which it has acquired by falling 13.38 ft., and two parts that which it has taken from the boat. If the weight were heavy enough it would stop the boat or even push it backward in the act of descending the plane. In any case it retards it just so much, and thus absorbs this extra energy. By assumption and the alleged explanation a bird stores energy in its body the same way in sailing downward with the wind.

Now, if the weight at this velocity were suddenly to encounter an opposing plane fixed relatively to the earth, there can be no doubt what would happen. The plane would "scoop it up" and the rolling weight would mount thereon to the height due to its velocity of 40 miles per hour, which is four times that due to its preceding fall of 13.38 ft. On the other hand, if the weight at the foot of the plane were to encounter a semi-circular track fixed to the deck, which carried it around to a second (and then opposing) plane parallel with the first, there can be as little doubt what would happen. The ball would roll back up the plane to its original height of 13.38 ft. less the loss by friction (which is disregarded) and then come to rest.

The apparent inconsistency in these two results is explained by the fact that in rolling around such a deck semi-circle the ball would and must surrender the energy which it has taken from the boat in descending by forward pressure against the "outer rail" of the semi-circular track. In other words, its connection with the boat being unbroken, its whole motion must be studied with relation to the boat only, considering the latter as a fixed surface. All motion is relative. The earth itself is only fixed with reference to terrestrial objects, but as all motions which we study are those which take place on its surface we are warranted in assuming it to be fixed in studying terrestrial dynamic problems. Similarly, motions which are confined exclusively to the interior of a moving train, are not affected by the motion of the train, but are subject to the same laws as if the train were still. All the bird's motions are obviously with reference to the earth, since the way in which it rises from or descends to the earth is the very issue we are discussing.

Our correspondent claims that a bird which suddenly turns into the wind from going with the wind must be considered as in effect going around a curved track of the kind explained fixed in the air, and so surrendering back to the air whatever energy it may have taken from it. If this were so, his argument would be sound, but it is not so. There is no fixed track around which the bird passes inertly. Its nature enables it to change its direction of motion by ricocheting against the air somewhat as a billiard ball does against a cushion or by moving in a curved path as a ship may in water; in each case, without any theoretical or large practical surrender of velocity. Theory indicates that they may do this (and must, in fact, as explained below), and it is an easily observed fact that they do do it.

Let us ask our correspondent: Has he ever watched the true soaring birds, of which the carrion crow or buzzard is the best example, soaring around for hours just above the trees and housetops, without the slighest beating of the wings, in a perfectly steady and horizontal trade wind of, say, 20 miles per hour; and, under such conditions observed the actual maneuvers of such birds? If he has not, then he as yet lacks by far the best chance for studying how the bird can or cannot take lifting energy from the air in which it floats, and for observing whether it does or does not change its direction in air only as a ball might roll inertly, around a curved track, because there are few or no true soaring birds on this latitude, and those which come nearest to it, like the fishhawk of the coast, soar too high to make their movements easily observed, and usually soar round and round in easy circles, so that the true philosophy of their movements cannot easily be detected.

But the habitual maneuvers of the carrion crow reduce soaring flight to its elements, and are made so slowly, repeatedly and easily, right before our eyes, as to make them the best possible object lesson on the true mechanics of flight; and an indispensable one. And it is a fact which all those who have studied their flight know, and which most of those whose observations are confined to these latitudes know nothing about, that these birds' habit is alternately to shoot downward with the wind at an angle of about 10° with the horizon and with a final velocity of 50 or 60 miles per hour, and then to give a little flirt to their tail which "in an instant, in the twinkling of an eye," throws them around into the wind so that they are next seen going against it, slowly rising at a little steeper angle than they descended on, or at any other they please, and passing through the air, against the wind, for four or five times as long and as far as they descended, but at much slower speed. This they do in flock over and over, often varying their maneuvers with more or less side motion, but always following the same general routine, and always with an indescribable air of lazy ease which proves it is rather easier work for them than standing still upon their feet.

Now, in the first place, it will be seen that it is simply impossible that the bird's body should surrender the energy due to motion at 50 or 60 miles per hour as quickly as it is turned to face the wind, for that is practically instantaneous. If it did, in fact, do so, the concussion would kill the bird. And in the second place, there is no more reason why it should than that a ship should surrender its velocity when its rudder is turned so that it sails about in a semi-circle instead of going straight ahead. And finally, as to the question of taking energy from the air, it is mathematically certain that if the bird did not gain and keep more velocity from the act of descent than that due to the fall, somehow or other, it never again could rise to quite the height from which it fell without beating its wings, and so in purely soaring flight would soon fall to the ground. Yet, they never do, but on the contrary, when the notion takes them, they go on rising in the air by circling until a mile or two high, and always with motionless fixed wings. Moreover, these birds are very logy and lazy, and hardly ever fly at all except when the wind is blowing, proving that the wind and not their muscles does the work for them.

A correspondent from Binghamton, N. Y., writes us another letter on this subject questioning the conclusions of the paper referred to on the express ground that a bird cannot "by a mere maneuver in the air receive force from the wind to raise it in the same air higher than the starting point." The fact that they do so, is, he says, an "assumption" which he proceeds to controvert and deny. But it is not assumption; it is established fact; and carrion birds may be observed doing it daily for hours together in all tropical and subtropical regions. We do not publish his letter because no technical paper can give place to an argument "controverting established fact." Any one who begins an argument by denying that to be possible which thousands of persons see millions of birds do every day in the year cannot possibly reach any sound conclusions from his premises. Therefore, he will see the necessity of reconstructing his reasoning to conform to the facts, and when he does, we think he will have no further difficulty in accepting the substance of the explanation of the phenomenon advanced in these columns last week.

Another correspondent, whose letter appears elsewhere, Mr. Geo. Y. Wisner, has recognized one obligation which some others have forgotten, that no criticism of disputed points in a theory which, if correct, accounts for established facts should be accepted otherwise than tentatively unless some other method of accounting for the same facts is advanced, consistent with the conclusions of the critic. Our correspondent advances such a theory of which an alleged "well known fact" is the premise, that "wind velocity is never uniform," and from it reaches the conclusion that birds soar without work "by taking advantage of the constantly changing velocity of the air."

The conclusion is not a new one; it has been often advanced before; it might possibly suffice to explain the phenomenon except for one fatal difficulty: Its premise is unsound and untrue. So far is it from being true that in the regions where soaring birds most abound along the seacoast of tropical regions the wind blows absolutely uniform for hours and days together and for a great depth above the earth. This is strikingly shown to any one who has been in a "norther" on the Gulf. Though a fierce gale is blowing it is so perfectly uniform that loose ropes which are merely tied at one end assume a much bowed position in which they are as rigid as if bars of iron. Temperate America and Europe, in which the scientists of the world mostly live, has highly variable winds, temperature and weather; but this should not blind us to the fact that taking the earth as a whole such irregularities are the exception and not the rule.

In the only other regions of the world where soaring birds much abound, the upper atmosphere of temperate regions, we have every reason to believe, and no reason to disbelieve, that within (and far beyond) the moderate limits of time and space within which a soaring bird may be observed moving in any direction with nonchalant ease and certainty the wind is absolutely uniform in direction and velocity, and that the changes in either come only slowly. Certainly there are often strata in the air moving with different velocities and directions, but so far as reason and experience can indicate, these are few in number and of immense thickness. It is precisely where gusts and eddies do exist, the lower air which is affected by the topographical irregularities of temperate regions, that soaring birds are never found; and precisely where the air is most nearly uniform and horizontal in its motion that they most abound.

Our correspondent's affirmative theory falls to the ground, therefore, for lack of conformity to fact. His parallel with a river steamer is most delusive, because it refers to motion in a horizontal plane only of a body no heavier than the fluid it displaces, whereas the evolutions we are discussing take place in space of three dimensions, and the bird is so heavy that a considerable time must elapse before it can surrender much of its energy to the air when moving at high velocity. We will turn instead to his fundamental difficulty, that a bird can only turn in air by using it as a kind of fixed track, such as a dead weight might need.

As to that, as we have already said, the bird has a peculiar power which is certain as a matter of fact, though we have no sort of parallel for it in surface locomotion; so that it is outside the realm of our experimental knowledge, and thus peculiarly difficult to grasp effectively. This power is that of changing the direction of motion almost instantly without any sensible surrender of velocity or energy, by throwing itself against the elastic air so as to carom against it, so to speak, precisely as a billiard ball caroms against the elastic cushion of the table, and almost as completely and quickly; for, although the bird does not often choose to exercise this power by completely reversing its direction of motion, yet the soaring birds especially may be often seen reversing their direction by turning in a semicircle of such small radius that the reversion is complete in a fraction of a second, so that the eye can hardly follow it before it is over. Still more often, the bird turns an instantaneous right angle and a second or two later turns another one. If any one comprehends this power of the bird to change its direction of motion without losing energy, and also comprehends that a body moving through space in any direction at a given speed has a certain fixed store of energy which it can expend in motion against resistance in any other direction if directed to that end, there should be no difficulty in perceiving that a bird moving at a given instant with the wind and at a common velocity with it, may by turning into the wind rise to a considerable height in it, corresponding to these opposing velocities.

LETTERS TO THE EDITOR.

CONCERNING MONTREAL FLOOR CONSTRUCTION.

Sir: In your issue of Oct. 12, one of your correspondents draws attention to some floor beams in a church on Dorchester St., in this city, under heading of "A Weak Floor Construction." As I have had the same brought to my notice by several parties, I would feel obliged if you would state that the above article has no connection whatever with the new Knox Church on Dorchester St., of which I am the architect, and which is now under construction.

Yours truly, Edward Maxwell.
Montreal, Oct. 19, 1893.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS' REPORT ON "PROFESSIONAL STATUS."

Sir: Owing to an unfortunate misunderstanding the draft of the report of the Committee on "Professional Status" has been printed and distributed to the members of the society before the members of the committee had all had an opportunity of seeing it.

As I cannot reach the profession through any channel so rapidly as through the medium of your columns, will you permit me to state that no report will now be made and the whole question will be reopened at the next annual meeting of the society?

Respectfully, Alan Macdougall,
Chairman Com. on Prof. Status Can. Soc. C. E.
Toronto, Oct. 21, 1893.

ERRATA IN HENCK'S AND OTHER FIELD BOOKS.

Sir: Please note error in Henck's Field Book (earlier editions at least), and also in Searles' Cotan 8° 07' reads 6.91174; should read, 7.01174. Yours truly,

George C. Power.
Ventura, Cal., Sept. 25, 1893.

(Other errata existing in many editions of Henck's Field Book are the following. Those which also exist in some editions of Shunk's (Sh.) and Searles' (Sea.) field books are also indicated.—Ed.)

Square root of 110	should be	10.4880885,	not	10.4880985
Square root of 138	"	11.7473401	"	11.7473444 (Sb.)
Square of 667	"	444,889	"	441,899 (b.)
Cube root 936	"	9 7819	"	9.78 9 (Sh. Sea.
Log sin 12° 30′	"	9.335337	"	9.355337
Log sin 33° 37′	"	9 743223	"	9.743233
Log sin 33° 49′	"	9.745494	"	9.745594
Log cos 34° 55′	"	9.913806	"	9.913866
Sin 38° 04′	"	61658	"	.61958

to which add, as above,
Cot 8° 07′ should be **7.01174**, not **6.91174** (Sea.)

EFFECT OF RATE OF INCREASE OF LOAD IN CEMENT TESTING.

Sir: In the use of any testing machine for testing cement in tension it seems that the rate of increase of load affects the breaking strength of the specimen, and that the maximum load increases with some function of the speed with which the load is applied. Is there any recognized standard in commercial testing defining this speed? Or is each engineer left to his own judgment in the matter?

With Portland cement mixed 1 to 1 with quartz sand I have had the breaking load for seven-day test to vary from 137 lbs. when load was uniformly applied in 18 minutes to 200 lbs. with load applied in one minute, with intermediate test varying somewhat uniformly between these two. Can any of your readers give recognized practice on the subject?

Yours, etc., C. B. Smith.
McGill College, Montreal, Oct. 16, 1893.

(In testing metals, timber, etc., the law has been practically established that a specimen failing under a load applied continuously for a long time will sustain a greater load quickly applied; and the reason given is that in the first case the particles have time to assume the form least adapted to resistance. The results given for cement by our correspondent seem analogous to this effect in other materials. We do not find any special reference to this particular effect in the many treatises and discussions upon cement testing and know of no recognized standard in commercial practice. We notice, however, in the abstract of a paper by Mr. Henry Faija, the English cement expert, which is published on another page of this issue, that 400 lbs. per minute is specified as a standard rate of loading.—Ed.)

THE MECHANICS OF FLIGHT—"POTENTIAL LIFT."

Sir: I think that the writer of the paper on the "Mechanics of Flight," etc., in your last issue (Oct. 12) has overlooked an important circumstance in regard to what he calls "potential lift." It seems to me that the claim as to potential lift, or "velocity head," or height to which, in consequence of initial velocity, a body can be guided by the use of frictionless inclined planes or curved guides (real or virtual, stationary or moving horizontally, with uniform velocity) should expressly state that the initial velocity to be used in the computation for "velocity head" is the initial velocity relatively to the inclined plane, and not relatively to the earth (unless the inclined plane is not moving).

Let us take a familiar instance. The water that lies motionless in a long trough close alongside and parallel to a railroad track running north and south has a zero velocity relatively to the earth just under it; i. e., its "absolute" velocity is zero. Relatively to a southbound locomotive, however, approaching with an absolute velocity of 20 miles per hour, the water has a northward velocity of 20 miles per hour. The potential lift, therefore, under these circumstances (i. e., with reference to causing the water to mount into the tender) is not zero, but is 13.38 ft. The locomotive does not slacken speed, an inclined trough is let down from it into an inclined position, the lower end dipping just below the surface of the water. The water now rises along the trough and flows into the tender.

Similar considerations should guide us, it would seem, in the case instanced at the foot of the first column of p. 287 of your last issue. The bird is here an aeroplane, since he (let us personify it) is not to flap his wings. At the beginning of the descent he has a relative velocity of zero and a horizontal absolute velocity, toward the left, of 20 miles per hour. At the foot of the slope (if we suppose the last small portion of the incline to be curved out to horizontal tangency) he is moving with a horizontal relative velocity of 20 miles per hour toward the left, and consequently with an absolute velocity, horizontal and toward the left, of 40 miles per hour. If he is now to be guided upward by the use of another inclined plane formed of a portion of this same mass of moving air, should not the potential lift be computed from the relative velocity 20 alone? The potential lift on this basis would bring him back to his original level and no higher.

If at the foot of the incline he should suddenly turn into the wind's eye, this would occur with the aid of a curved guide consisting of a portion of this same mass of moving air, and without appreciable change in position vertically. Hence the relative velocity would remain 20 miles per hour, and as this is now directed horizontally toward the right, the absolute velocity at the end of this maneuver would be zero, it seems to me, and not the 40 miles per hour implied on p. 287. As a further illustration bearing on this point, we may recall the fact that for the best working of a Pelton water wheel the absolute velocity of a cup is regulated to a value about half that of the water in the jet that is overtaking it. The water particles are guided over the curved surface of the moving cup without notable change in relative velocity. The direction of this relative velocity, however, at the instant the water and cup part company, is practically parallel and opposite to that at entrance; so that the absolute velocity of the water particles at that final instant is zero. In other words, by this maneuver all the energy due to the original absolute velocity of the water has been given up.

I have seen no report of the discussion that may have occurred at the time of presentation of Mr. Wellington's paper before the conference, and it is quite possible, therefore, that some one may have anticipated me in dissenting from his conclusions in this case of the bird and potential lift.

Ithaca, N. Y., Oct. 14, 1893. I. P. Church.

(We have discussed the issues raised in this and the following letter on another page, where we endeavor to make clear that they arise only from imperfect assumptions as to conditions with which we, as terrestrial animals, are quite unacquainted practically, and which we are therefore extremely likely to misjudge.—Ed.)

Sir: In Engineering News for Oct. 12, Mr. Wellington has given a very able discussion of the laws of force utilized by birds when soaring. If I understand his theory correctly, however, the following point will need some modification to make it accord with the laws of moving bodies:

> "We will suppose the wind blowing steadily at 20 miles per hour, and the bird to be moving with it, also at 20 miles per hour. . . . To keep on flying when in this condition the bird has the choice of two alternatives, and only two. It may turn against the wind, lose velocity and rise, or it may turn into or with the wind, gain velocity and fall."

As the bird is moving at a uniform speed with the wind, if he turns against the wind there would be no reaction on the atmosphere from the wings, and consequently no force brought into action to cause the bird to rise.

Again, if the bird turns with the wind and falls until a speed of 20 miles per hour through the air is attained, there is no question but that, with reference to any point in space, the bird will have energy stored corresponding to a velocity of 40 miles per hour, but with reference to the supporting medium a relative velocity of only 20 miles per hour. As action and reaction are always equal, the bird in turning can only exert a pressure due to this relative velocity, and therefore would have a velocity of 20 miles per hour through the air after turning against the wind, and would be at rest in reference to the point in space. The result is somewhat analogous to that of a vessel sailing with the current in a river.

For instance, if the boat is moving through the water five miles per hour with a five mile current in the same direction, a sudden turn of 180° would bring the boat to rest in reference to the river bank.

If, however, the boat should enter an eddy at the instant the turn is made, the reaction would be that due to a ten-mile velocity, with which speed, less loss due to friction, the boat would move up stream.

In a similar manner if a bird flying 20 miles per hour with a 20-mile wind should enter a still stratum of atmosphere at the instant the turn is made into the direction of wind, the reaction on the wings would be that due to a 40-mile velocity, and consequently would store up energy due to that velocity.

It is a well known fact that wind velocity is never uniform, and therefore the bird soaring on a windy day always has the necessary forces at command with which to accumulate energy for rising to almost any height. For instance, a bird flying 20 miles per hour through the air, with a 20-mile wind, would have a 40-mile velocity through space.

If when this velocity is attained we suppose that the bird enters a stratum of air only moving five miles per hour, and then makes the turn against the wind, the reaction on wings would be that due to the difference of velocity of the bird and of the wind, or 35 miles per hour, and the bird would move back through space at 30 miles per hour.

If after the turn is made we suppose the 20-mile breeze to be again encountered, the bird's motion through the air would be 50 miles per hour, or sufficient to lift the bird 83 ft. against the force of gravity.

There is no question but that soaring birds do rise to great heights without action of wings, and in my judgment the energy is obtained by the bird by taking advantage of the constantly changing velocity of the wind.

Detroit, Oct. 16, 1893. George Y. Wisner.

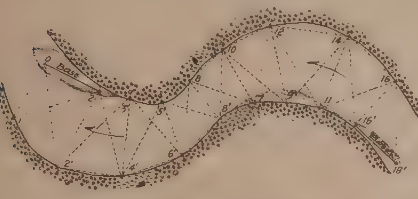
(The trouble with our correspondent's theory is that it is not consistent with the facts; soaring birds most abounding in trade and other perfectly uniform winds, as we have shown more fully on another page.—Ed.)

TRIANGULATION ON RIVER SURVEYS.

Sir: Mr. W. G. Kirkpatrick has pointed out (Engineering News, Oct. 12, 1893) a very economical and convenient system of triangulation for small streams, and every one engaged in such work would do well to read carefully his paper, remembering, of course, that any method in which but two angles of each triangle are read can only be employed on a small stream, otherwise so many bases would have to be measured as to destroy its main merit, economy and swiftness. That is, the error of closure for each triangle not being known, after the run from one measured base to another has been made, and the difference between the computed and the actual length of the latter determined, there is no known method by which the errors can be distributed between the several stations. Even in the most accurately conducted work, where no adjustments are made, a difference of several feet can easily be accumulated betwen 30 stations. Mr. Kirkpatrick, however, provides for this by the statement that "for greater accuracy the two angles at each odd-number station may be read by the transit instead of being found by difference as above."

In river work, where triangulation is necessary, the two following conditions are generally met with: The course is sinuous with or without straight reaches between the bends; and the banks are more or less heavily timbered. With these obtaining, the method indicated by Mr. Kirkpatrick, unless modified, would prove vastly expensive instead of economical, for with all "open" lines on one bank and all "blind" ones on the other, when the open lines were on the convex side a great deal of cutting would be necessary.

The accompanying sketch shows a modification of the above mentioned method for crooked streams with banks heavily timbered. Here the open lines are always on the concave side, giving a clear sight over the water and requiring a minimum amount of cutting. If the objection is raised that the observer has thus to cross the river frequently, thus losing time, it may be effectually answered by those who know how long it takes to clear out timber, even the lightest, sufficient for a sight. Three good axemen will do well if they cut out a road 6 ft. wide and from three-quarters of a mile to a mile long in a day of eight hours, even through the lightest timber, cottonwood and willow. By employing the method indicated above, the services of two of these men may be dispensed with, one only being required to handle the skiff and do what little cutting is necessary in front of the stations. Of course on a straight reach many trees must, of necessity, be felled, and on a river with few or no bends, or little timber, Mr. Kirkpatrick's method may be employed without the above modifications. Even numbered stations may indicate the extremities of open bank lines, plain even numbers on the right hand bank, primed even numbers on the left, while for the odd stations this may be reversed. The computer would then know without a sketch when a crossing had been made and could also follow the windings of the stream, thus having a rough check on his deflection angles, knowing the open lines were always on the concave side, blind ones on the convex. Nor could confusion arise in the computations if a rough sketch of the triangulation system be made in the note book with the stations properly numbered as placed. The notes could then be kept as indicated in the paper referred to, with the finished sketch as guide.



Triangulation on a River Survey.

The system of checks by plotting on a large scale using chords instead of angles is an excellent one, but, of course, could not be employed to advantage where the triangle sides are much over 500 to 600 ft. long.

In connection with the subject of cutting between stations, it is important that the line of sight should be as near as possible down the axis of the cut; all overhanging branches should also be cut away so there may be no shadows. The writer recalls one instance that illustrates the importance of this. A cutting about three-quarters of a mile long was made between two stations over two miles apart; it was somewhat off line so that the line of sight was for a part of the distance in the light and for a part in shadow. The triangles in which this line was used would not close by several minutes, although all angles were read by ten repetitions both ways on a transit graduated to 30 seconds. Several trials were made with about the same result. After the cutting had been straightened and broadened so as to bring the line of sight always in the light, the triangles were made to close within the allowable limit which was for this system 12 seconds. Of course the refraction must have been abnormal at the time, but it serves well to illustrate the necessity of broad clear lines between stations that are far apart.

Very truly yours,

Thomas C. J. Baily, Jr.

306 C. St. N. W., Washington, D. C., Oct. 14, 1893.

ENGLISH AND AMERICAN RAILWAYS.

Sir: I have been very much interested in your papers on English and American railways, as your railway articles are very good. I quite agree that one cause of so much use of the vacuum brake instead of the Westinghouse brake on British railways is insular prejudice and an objection to anything new, especially if of foreign origin. This is more especially the case in England, where you have to deal with the most conservative and self-satisfied race on earth. In Scotland it is different, as the Scots, though conservative, are also very cosmopolitan, and are born engineers; hence Nasmyth, Watt, Murdoch, Henry Bell, Livingstone, Mungo Park, and other explorers, inventors and pioneers. As to English railway management, you are quite right, and the incredibly blind eyes of railway magnates are at last being opened to see that passenger traffic is the most paying, and that it is developed by comfort, speed and facilities, as against the old idea of carrying those who must travel in the worst and cheapest manner possible.

This last summer a great step in this direction has been taken by Great Britain by the splendid new trains which have been put on by the three great routes between London and Scotland. The train over the Midland Ry. and Glasgow & Southwestern Ry. was described in Engineering News, July 6. All three routes have both first class and third class dining cars (common sense has at last killed the second class) and on the East Coast and West Coast routes the trains are of corridor cars, and vestibuled so that one can walk from end to end. On the Midland route, however, they simply stick dining cars into an ordinary train, so only those can dine who start and stay in the car, an ancient way of doing things which must soon disappear. This route, however, has by far the finest dining cars. Weighing as they do 33 tons, and being 60 ft. long, and carried on two six-wheeled trucks, the absence of movement and vibration at 76 miles an hour is simply incredible. The West Coast (London & Northwestern Ry. and Caledonian Ry.) dining cars are only 50 ft. long and weigh about 24 tons on two six-wheeled trucks (Engineering News, April 27), but they are too light and rock very badly. The East Coast (Great Northern Ry. and Northeastern Ry.) dining cars are still smaller, have only eight wheels, and are quite uncomfortable to dine in. With the exception of the dining cars the train is made up of the ancient six-wheel (rigid wheel base) coaches, a piece of obstinate folly which flies in the face of theory and practice, and they are suffering much for it, as the kitchen car, which is a six-wheel car, between the two dining cars, has had to be taken off twice in 20 days, owing to a hot box, and on the first day that the train ran two hours were lost in taking off a coach for a hot box. Of course no kitchen, no dinner. The friction on axle boxes of rigid axles is something awful whenever the line is the least on a curve and the speed high. You will hardly believe it, perhaps, but the East Coast joint stock train was, so to speak, made up in one piece from end to end, i. e., the vestibules could not be detached, so that on the first day it took them two hours to chop off bolt heads with a cold chisel in order to take off the coach, and even now, with their new and wiser management, it takes half an hour to get a coach off, and 40 minutes to couple one in.

Your articles on English and American railways are very good indeed, and I mostly agree with you, but I think you are wrong about the wooden keys for the rail fastening. I fail to know of anything theoretically or practically better, and I think everything else has been tried, and nothing so well stands heavy, frequent and fast traffic. Under a recent Act of Parliament every mile of line in the United Kingdom is worked on the absolute block system and equipped with interlocking plant. On one point I do not think you give us due credit, and that is our locomotives, for I do not think that either in design, or certainly in workmanship, the American locomotive can touch the British. I am fully aware of the great loads hauled and the unbeaten speeds of American engines, but I think this is done regardless of expense, and that an American design of locomotive is not economical in any way. In short, if you exchanged all of, say, the Midland Ry. locomotives for American built engines, there would be no dividend. There is really no important railway in this country which builds new engines with outside cylinders, and every railway except the Great Western Ry. and London & Northwestern Ry. uses four-wheel trucks or bogies on its passenger engines. As to workmanship, I have a friend staying with me who has worked on the New South Wales railways, where they have a number of Baldwin engines, which in workmanship and the amount of repairs required are, he says, most inferior to engines by Neilson & Co., of Glasgow; Beyer, Peacock & Co., of Manchester; and Dubs & Co., of Glasgow, all of whom have supplied many locomotives to the New South Wales Railway.

As for passenger rolling stock we are simply years behind America in every single point, and your remarks are very good and indulgent to us. The only point America has to learn from us is in taste, the outside and inside decorations of American cars being downright ugly. The British goods truck is nothing more or less than a crude absurdity. I have great hope that many of our railway officials will visit Chicago this year and so see some points on which we may well follow the lead of America. I remain yours faithfully,

Norman D. Macdonald.

Edinburgh, Scotland, Aug. 20, 1893.

(Our correspondent's letter shows very clearly the great advance that is being made by English railways in providing for the comfort and convenience of their passengers, and thereby developing their traffic. As to the wooden keys which fasten the bullhead rails in the chairs, it is a fact that they do work loose, and in our "Notes on English Railways," in our first volume for 1891, reference was made to different methods for preventing this by means of nails, shims, etc. In regard to American locomotives, Mr. Macdonald is certainly misinformed, both as to work and workmanship. We do not put bright work and finish on our engines for appearance sake, and the present tendency is to use black paint and planished iron with a minimum of striping and bright work. But in construction, the workmanship is excellent. Ordinary English locomotives could not haul at any speed the enormous express trains of 320 to 475 tons behind the tender (Eng. News, April 13, 1893) which American engines handle regularly. Taking the heavy and continuous traffic to Chicago this summer it may safely be said that English engines could not have handled such traffic with any degree of success. Our engines are forced more than English engines. American engines have abundantly proved their efficiency in New South Wales, New Zealand, etc. (Eng. News, July 21 and 28, Aug. 18 and Sept. 22, 1892, and Jan. 26, 1893), and we will not reopen that question, but merely point out that English builders give American builders the sincerest form of flattery in imitating (not always successfully) their practice in English-built engines for foreign and colonial service. Canada uses American types exclusively. As to the use of the leading truck, English locomotive builders have only adopted this American feature slowly and grudgingly, as they have adopted some other features of American practice. We must disagree with our correspondent also as to the finish of our passenger cars. Certainly he must be forgetful of the scratched and dirty paint on the interior of many English cars, and forgetful also of the funereal exterior of cars of the Southeastern Ry. and the ugly buff and brown of the London & Southwestern Ry., while he has probably not seen the handsome and artistic interior finish of our modern cars and the handsome exteriors of the dark blue of the Blue Line Express cars, the tuscan red of the New York Central and the natural mahogany (in narrow, vertical strips) of the Canadian Pacific. To compare new and exceptional English cars with older American cars is not a just comparison. In spite of this, however, our correspondent evidently shares with Mr. C. E. Stretton the opinions which that engineer expressed in a letter written after a visit to America this year, published in our issue of Aug. 24, 1893. The next few years will probably see many changes on English railways.—Ed.)

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Liability of City for Delay in Raising Fund.

A stipulation in a contract by a city, for a public improvement, that the contractor shall look for payment to a particular fund to be raised by assessment does not relieve the city from liability for negligently delaying to raise such fund.

Commercial National Bank of Portland v. City of Portland. Sup. Ct. Ore. 33 Pac. Rep., 532.

Damages for Changing Street Grade.

An abutting owner is entitled to damages for change of street grade, though it had never before been established, and though it is made in improving the street and placing it on a proper grade. The measure of damages is the difference between the market value of the property immediately before and after the change.

City of Ft. Worth v. Howard. Ct. of Civ. App., Tex. 22 S. W. Rep., 1059.

Assessments for Municipal Improvements.

A special assessment for a local improvement is void where a portion of the property benefited is arbitrarily and intentionally omitted from the assessment, and that, too, though the property assessed is benefited the amount it is assessed.

Masters v. City of Portland. Sup. Ct. Ore. 33 Pac. Rep. 540.

Unlawful Changes of Street Grades.

Plaintiff filed with the clerk of defendant city a claim reading "For damage caused by change of grade, $1,500." On its being disallowed an appeal was taken, whereupon he filed a complaint for damages for unlawful change of grade. The cause of action had not been changed from a claim for damages because of a lawful change of grade to a claim for damages because of an unlawful change of grade. For an unlawful change of street grade the city is liable to an abutting owner for all damages naturally resulting therefrom, against which it cannot offset appreciation, in value of the property, in common with other property in the locality, caused by the change of the grade.

Drummond v. City of Eau Claire. Supr. Ct. Wis. 55 N. W. Rep., 1028.

HEATING AND LIGHTING STREET RAILWAY CARS.*

By G. F. Greenwood.

In this paper I intend to give the results of some investigations and my experience of heating and lighting cars. Considering heaters in the manner in which the fuel is converted into heat we can divide them into three classes: (1) Primary heaters, or those in which the heat is obtained from fuel consumed on the car. (2) Secondary heaters, or those in which the heat is generated beyond the car and transmitted to some storing medium. (3) Electric heaters, or those of three conversions.

Primary Heaters.—I have included in this class all stoves, oil burners and hot air heaters. There are many devices on the market for accomplishing a method of heating directly from coal or other fuel burnt on the cars. These may be divided into three classes, as follows:

Heaters fired from the inside of the car (1) above and (2) below the floor, and (3) those fired from outside the car.

If a heater of either of these classes is used I would suggest that it be complete in itself, occupy as little room as practicable, and be fired and operated from the inside of the car, and that anthracite coal be used as fuel.

The plan of operating these heaters on street railways is to have one man to 50 cars to clean stoves, build fires and fill coal receptacles, the conductor on each car to care for the firing while the car is in transit. Before a car equipped with one of these heaters goes into the car station it is well to have the fire dumped and the hot ashes removed, so that no risk from fire in the station will be incurred.

Good heaters of this description can be purchased at from $15 to $24 per car, and can be installed at a cost of about $1.50 per car. The cost of operating such heaters per car per day of 18 hours with anthracite coal at $4.75 per ton, labor at $1.50 per day, and maintenance 25% of the cost of stoves, is as follows: Fuel. 8.7 cts.; maintenance, 3.8 cts.; labor, 3 cts., making a total of 15.5 cts. per car per day.

Secondary Heaters.—In this class there are two types, one using steam and the other water. In the first type steam is used to heat earthenware cylinders or tubes placed in iron pipes, and in the other heated water is forced into radiating tubes in the cars. These iron tubes or radiators are placed under the seats with pipes leading through the floors to the outside, where some form of steam or water coupling is provided. At the charging station a rubber hose connected either with a steam boiler or with a hot water supply is equipped with some form of valve. When a car reaches this station it is necessary that a man be in attendance to connect the discharge and supply pipes, to open and close the valves, as the conductor's time will be more or less occupied at the termnius of the trip accounting for his work.

This requires some time, but from experience on our road with steam heating I would say that it can be accomplished on the average in about three minutes. In the water system of storing heat, it is well to have the water impregnated with salt to prevent freezing in winter, and it is necessary to have at least two men at the charging station, providing the generating station is located near at hand, so that one man can fire the boiler and charge the cars. This, however, will hardly be possible unless it is on a small road. On a road operating, say, 50 cars, it will require at least four men if all the cars pass through the charging and generating station. This type of heater is at present in an embryo state, and I cannot give reliable figures as to cost of operation.

Electric Heaters.—These are constructed of wire or other electrical conductors placed in and around a noncombustible material, and the heat is generated by raising the temperature of the wire by a current taken from the power station of the road. The amount of heat produced in these heaters is proportional to amount of current used. These heaters, usually four in number, are placed under the seats of cars in such a manner as to protect passengers' clothes from contact with them. It is necessary to install them with some form of regulating switch, and the cost per car varies from $35 to $45, installed.

To keep the temperature of a car at 50° F. in moderately cold weather requires an expenditure of from 5.33 HP. to 6.66 HP. Estimating power to cost 0.9 ct. per kw.-hour, we can arrive at the cost of heating a car per day of 18 hours as follows:

In moderately cold weather, using 2.66 HP., or 36 kw.-hours, the cost will be 32.4 cts.; using 6.66 HP., or 90 kw.-hours, the cost will be 81 cts. To this cost must be added the depreciation and repairs, and this we can take at 20%. This will add to the above cost of operating 5.1 cts. per day.

It may seem to some of you that this is an excessive cost for an electric heater; but it must be remembered that it means the consumption of just so much more electrical energy, and the heaters should properly be charged with what this energy costs. It may be argued that it costs no additional labor to operate electric heaters, and the only expense will be the extra coal burned; but this is rather a lax way to look at the matter. We cannot add the consumption of so much more energy to a road without a corresponding increase of expense, whether it is appreciated or not.

Thus, considering all the elements of the car heating problem, I consider the best method to be the use of a primary heater fired from inside the car with anthracite coal. Among my reasons for this are: A street car is open to the weather, either constantly or at very short intervals, and therefore a heater which can rapidly counteract any inflow of cold air is better appreciated by the passenger, and in addition there is a certain attraction in the burning of coal which gives a quiet sense of satisfaction to the passenger. He feels grateful to enter a street car with a good warm stove in it. This method is easily understood by employees, is simple in operation and maintenance, economical and efficient.

Concerning street car lighting, three methods are in use, oil lamps, electricity and gas. The first method of lighting I need only mention here.

Electric systems of car lighting are on the whole about duplicates of the first street car wired for incandescent light. I will, however, describe a few changes I have made with considerable economy. In place of oil headlights I have placed an incandescent light in each lamp box at the ends of the car, so that the colored signal light may be distinguished readily. I have also used incandescent lights to illuminate the advertising rack over the windows. On the ceiling of the car are two more incandescent lamps located about 4 ft. from each end. By having a divided circuit the fifth light to make up the circuit is used in headlights on the hoods of car. The result is we use a minimum number of incandescent lights in a car, obtain the best lighting effect, remove the annoyance of oil headlights, and the labor attending their use, and facilitate changing ends of car at a terminus. The cost of lighting by this method need not exceed ½ ct. per hour, or 4 cts. per car per day, estimating that a car will burn its lights eight hours on the average.

The third method, that of using gas, is to-day the most successful and agreeable method of car lighting in use on steam railways, and has been adopted by some of the cable railways. I cannot speak from experience on this manner of lighting, but would say it should cost no more to operate than the use of oil lamps, the greatest difference being the interest on the cost of the equipment and installation for gas.

Good lights in cars assist employees to better attend to their duties, make the cars prominent on the streets, and thus attract traffic and to some extent enable the better lighted road to be operated with fewer accidents.

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*Condensed from a paper read before the recent meeting of the American Street Railway Association.

ENGINES FOR ELECTRIC RAILWAY POWER HOUSES.*

Good service and uniform speed of cars can only be maintained by a constant, unvarying potential, and in order to do this the engine must regulate practically perfect, so that there will be no variation of speed as the load varies. The varying power required on an electric railway is unquestionably considerable, caused by cars constantly stopping and starting, going up and down grade, rounding curves and using resistance in order to run slow through crowded streets (which necessarily increases the load), and in order to have perfect service and uniform speed of cars the engine must be constructed so as to maintain a constant and uniform speed under any variation of load. This variation of load amounts to a very considerable fraction of the whole maximum load; in small plants it may read 95% of the maximum, and in large plants is frequently 50%. If the speed of the engine decreases when a heavy load comes on, the potential is reduced, which consequently reduces the speed of the cars, heats the car armatures and creates an extra strain upon the machinery, which, of course, means an increase in the consumption of fuel, and in various other ways produces imperfect and expensive service. If the speed of the engine increases when the load diminishes, it consequently increases the voltage or potential, which is liable to result disastrously to the generators and cor motors.

The governor or regulator should be so constructed as to control the engine under any variation of load, with a variation of speed not to exceed 2%. which is practically perfect for street railway work, though there are engines on the market that, on electric railway service, can be held to 1% deviation from the mean speed. The governor should be constructed so as to be easy of access to all of its parts and capable of being oiled while the engine is running. Particular attention should be given to the construction of the governor to see that there are no weak parts, and it should be so constructed as to make it the least intricate and complicated. The range of cut-off must also be larger than in engines for less variable load. and should be easily regulated between the limits of 1-10 and 7-10 of the stroke.

The severe conditions of high speed and sudden and extreme variations of load make it especially important that the engine have the best possible construction, with extra weight in the flywheel and bedplate, and that the foundation be more than usually substantial.

In order to obtain the highest economy in the operation of an engine, it is necessary to have the engine properly adjusted to its load. It is a fixed principle that the highest engine efficiency results in working the engine constantly at its maximum rated capacity; underloading or overloading are each, therefore, undesirable, though the compound condensing engines of the largest stations will stand underloading better than the simple high speed engine, and both classes of engines will stand underloading better than overloading; there should then, be ample power both in boilers and engines to obviate excessive overloading as well as to provide for contingent breakdowns or needed repairs. Whatever the style or type of engine adopted, it should be kept scrupulously in the best possible working condition.

We are so accustomed to consider the reciprocating engine as the only steam motor within our reach that it is not surprising that a new form of steam motor should have quietly been developed without our notice. The committee refers to the steam turbine, one form of which, the Parsons steam turbine (Eng. News, Jan. 23, 1893), has recently been subjected to vigorous and searching trials and tests by Prof. A. D. Kennedy, of London, England, who has developed power at the rate of 20 3-10 lbs. of water per electrical HP. per hour in a turbine using steam at 97 lbs. per sq. in., and making 4,600 revolutions per minute, the turbine having a capacity of about 165 HP. The small size of this motor, absence of reciprocal motion and consequent independence of heavy foundation, high speed of rotation and consequent availability for gearing direct to generator, simplicity of construction and consequent low cost, and its very high efficiency as a motor, all tend to make this a strong rival to the reciprocation engine as a steam motor for electric power and light stations.

The next point to consider is the boiler-room, and the design and proper construction of the boiler plant are quite as essential to economy as is the case with the engine. The boiler plant should have ample capacity, as there are few cases when the draft and setting are so excellent as to allow heavy forcing without a serious loss of economy. A raising of the evaporation from 6½ to 7 lbs. of water per pound of coal represents the saving of about 7% of the coal bill, which would warrant the incurring of an expenditure for improvements equal to one whole year's coal bill.

Fuel is one of the largest items of expense attached to a power-house, and the waste of fuel by incompetent firemen is one of the greatest leaks attached to the operating expenses; it is a safe proposition to state that an incompetent fireman will waste enough fuel in a year to assist very materially in paying a dividend. A good plan to encourage economy on the part of the fireman is to pay him a coal premium at the end of each month, basing the amount of the premium paid on the average number of bushels of coal consumed each day during the month for a certain number of cars run. This plan was adopted by the chairman of this committee about two years ago with very satisfactory results. The limit on the average number of bushels consumed per day, to secure the premium, was placed at a point that required skill and economy on the part of the fireman to keep within the limit. During the past two years they have succeeded in obtaining the premium about one-half of the time.

Careful firing is a good smoke preventive. No matter if the draft is good, and the best quality of bituminous coal is used, unless the coal enters the firebox in the proper manner there will be more or less black smoke issue from the stack, representing a lack of combustion and waste of fuel. Careful firing, preserves the boiler and saves coal, gives a steady steam pressure, which secures an economical point of cut-off, and steam economy from a proper expansion in the cylinder. When the plant is of such size as to require more than two firemen, it will always be good economy to employ mechanical stokers; aside from their saving in labor account, they economize fuel, insure uniformity of steaming, prevent the chilling and straining of crownsheets by inrushes of cold air through the firedoors, and prevent smoke—that is, if properly chosen, constructed and operated.

The use of oil as fuel in place of coal is a live question with power and light station engineers and managers, and several comparisons have been made with sufficient care and accuracy to make them valuable witnesses. Probably the most complete evidence of this kind comes from a recent and exhaustive test of the power plant of the Twin City Rapid Transit Co., Minneapolis and St. Paul, Minn., made by Wm. A. Pike, of Minneapolis, and T. W. Hugo, of Duluth. On the comparative value of the two fuels, coal and oil, this test showed that with ordinary Lima oil weighing 6 3-10 lbs. per gallon and costing 2¼ cts. per gallon, and coal that gave an evaporation of 7½ lbs. of water per pound of coal, the two fuels were equally economical when the price of coal was $3.85 per ton of 2,000 lbs. With the same coal at $2 per ton the coal was 37% more economical, and with the coal at $4.85 per ton, the coal was 20% more expensive than the oil. These results include the difference in the cost of handling the coal, ashes and oil. The oil used gave the following as the result of the average of five chemical analyses: hydrogen, 13.03%; carbon, 82.38%. Evaporation, 20.63 lbs. of water from and at 212° F. per pound of oil.

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*Abstract of a report presented by Mr. E. G. Connette, Chairman of a committee on the subject, at the annual meeting of the American Street Railway Association, at Milwaukee, Wis., Oct. 18 to 20.

The average steam plant is not run at anything like a minimum expense. So long as the cars keep running little attention is paid to the efficiency and economy of the power plant.

The loss of power between the engine and switchboard terminals is from 15 to 25%, which is attributable to the inefficiency of dynamos, and also to the friction of countershafts, belts, idlers and attachments, which are simply power consumers, representing a waste of power without any resultant benefit. Besides the loss of power, the expense of maintaining the various arrangements for the transmission of power is quite considerable. This waste of power can be overcome by connecting the generator direct to the shaft of the engine. While machinery of this class is more expensive than the other because it demands a slow speed for the generator, necessarily increasing its size, the saving in power and maintenance of the machinery of transmission will be sufficient to compensate for the slightly reduced dynamo efficiency, due to slower rotation, and will warrant the recommendation of the direct driven equipment for moderate or large sized plants. This direct coupling of engine and generator gives also an important advantage, particularly in the large stations in crowded cities, by the considerable saving in floor space.

The committee look with favor upon compound engines for street railway work, especially so with engines having ranges of cut-off wide enough to keep the low pressure cylinders from ever expanding below atmosphere. When this is the case, there is no doubt that the compound engine is very economical, as it carries the expansion of steam to a greater limit. Where it is possible to condense in connection with the compound engine, there is not the slightest question as to economy. In fact, where condensing is possible, there is no reason why the expansion should not be carried to a further limit.

The practice occasionally followed of placing the generators in the second story of the power house is not to be recommended, even where floor space is difficult to secure. The difficulty of securing for the dynamos rigid foundations, and the resulting evils of increased frictional losses and heating, will generally render this disposal of plant inferior to placing the dynamos on rigid ground foundations, even if the problem of floor room has to be settled by direct coupling of generators to the engine or the incurring of considerable outlay for additional ground room. The plan adopted at the power station of the West End company, in Boston, of sinking the countershaft into a basement pit, keeping the generators on the same floor with the engines, is worthy of consideration for extraordinarily large plants as securing rigidity of foundations, necessary belt lengths, economy of floor space, without going to direct gearing of generators to engines.

When electricity was first introduced as a motive power for street railway transportation the largest type of generators were small units as compared with those manufactured at the present time, and high-speed engines from 100 to 200 HP., belted direct to the generator, were in most cases adopted without regard to the size of the plant. In some instances Corliss engines were installed and the dynamos connected to a countershaft. In nearly every installation mistakes of more or less proportion were made, not due, however, to the fault of the street railway people, but the lack of knowledge on the part of the manufacturer as to what was actually necessary to properly fulfill the requirements of the new field of traction. The size of the proper unit of subdivision should be such as to give the required relay or reserve above the maximum power adopted. This will apply equally to boilers, engines and dynamos. The following table will serve to show approximately the proper proportion:

Max. HP. req'd to operate road.	No. of engines required.	HP. of each engine.
200	2	200
400	3	200
600	3	300
1,000	3	500
1,500	4	500
2,000	4	750

It will be observed from the above table that enough engines are provided to furnish the maximum horse power required to operate a road and have a surplus of one engine. This is very essential, as it enables the engineer to keep his engines in perfect adjustment and repair, having at all times an extra engine to work on, or, in case of a breakdown, the extra engine is ready to take the place of the disabled one. The "Maximum horse power required to operate the road," referred to in the table, is not to be taken as the sum of the power needed by each car in service, except in case of small installations, since the maximum power required does not increase in proportion to the number of cars in use, as the line losses are not materially increased with increased traffic, and because as the number of cars increases the fluctuations of load tend to balance themselves and to reduce the maximum load nearer to the average load. Thus in a ten-car plant cases will occasionally occur when all of the cars will require their full power at the same time, and the power plant must be planned accordingly, but there is no probability that all of the cars of a 100-car plant will all require their full power at the same time; from 60 to 75% of this power, depending upon local conditions, will be sufficient for this plant.

The committee sent a list of questions to a number of street railways for such information as would be of service in formulating an intelligent report, by securing an idea of the construction and equipment of the various power plants, and the result of their operation and experience with the various types of engines in service. Only a small number made a reply, from which the committee would infer that a number of roads are not giving the question of the expense of the their power house much consideration. From the replies that were received the committee find quite a variety of types and kinds of engines in use, and no uniformity of opinion as to the best and most economical engine for power house work. In nearly every instance the kind and style of engine which the particular railway had in service was recommended as the best, showing that the observations and investigations as regards their power was restricted to their own power plant.

In selecting a type of engine the size of the installation must largely govern, as well as local conditions, such as water supply and price of fuel, though some consideration may be given to opportunities for station room and arrangement. For small plants to run 10 or 15 cars, simple high-speed engines belted direct to generators are unquestionably the proper choice. For 20 to 50-car plants, compound engines (with condensing apparatus where it is possible), with tandem compound engines for the smaller plants and cross compound engines for the larger ones, geared direct to generator, will probably be found most economical. For the larger systems compound or triple expansion condensing engines, using steam at a high initial pressure and either driving a countershaft or coupled direct to a generator, whichever the conditions of the case will warrant, will be found a proper selection. In every case, except for small plants, where engines are belted direct to generator, the vertical type of engine is recommended.

In conclusion, the committee desire to impress the importance of keeping the steam plant as near as possible to the conditions that exist when the engines are installed and being run under the supervision of the mechanical engineer who installed the plant. This, perhaps, is of as much, or more, economic importance as the design of the engine, as the plant is then run by the expert in charge with a view to attain the highest degree of efficiency and economy.

Discussion.

Mr. Connette, Nashville, Tenn.: The vertical type of engine, with generators geared directly to the shaft, I consider the best engine for power house work. It takes less floor space than the horizontal. In the horizontal type you are also liable to have trouble with the piston; in the vertical type this is not so liable. The vertical engine of the Intramural Railway plant at the Columbian Exposition is a 1,500-HP. compound condensing engine. It has a Thomson-Houston 1,200-HP. dynamo coupled direct to the shaft of the engine. I understand that this engine has never been shut down one hour for repairs to the engine proper. It has done its work day after day. It has hauled 13 trains of four cars, heavily loaded, constantly all day, while the other engines, those of the horizontal type, have required repairs. The committee appointed to examine engines in order to award premiums sat for 23 hours watching the engine work. It constantly pulled the whole load for 23 hours, with possibly not over 1% variation in the speed. The engine makes about 100 revolutions per minute, and it is said it did not vary one revolution when the load was increased from, say, 50% to full load. Our road was one of the pioneers in the business, and we have a great deal of trouble with our power house, being equipped with a large number of small sized engines. The question of fuel, as we know, is one of the largest expenses attached to the plant; and I strive to keep the coal bill down. When you have competent men in charge of your machinery, and intelligent firemen, there is no doubt about attaining the results. You do not want to allow any slipping back. The plant should be kept up to the efficiency attained at the start. An expert in charge of the installation will run the plant with the greatest efficiency, in order that his engines may be accepted, and you should endeavor to maintain that efficiency, or find the reason why you do not. The expert will state that he will put in an engine that will use 2½ lbs. of coal per horse power per hour; and if he does that, you will get good results. You should endeavor to keep your plant to that standard. If a boiler will evaporate 8 lbs. of water per horse-power per hour, that efficiency should be maintained. If you find that it does not evaporate more than 6 lbs., something is wrong, and you are losing a great deal in coal.

Mr. Arnold, Chicago: I am familiar with the engines at the Exposition, and have made a number of tests this summer. I can corroborate what the speaker has said, in most respects. The vertical engine installed in the Intramural Railway power station, on the whole, has done excellent work and has required very little repairs, in fact none to amount to anything. I wish, however, out of justice to the other types of engines, to say that they have done almost as well. You are aware that the horizontal engine in time wears its cylinder elliptical, by the passing of the piston through and through. One of the engines of that type gave some trouble, because it was operated continuously for six weeks at the opening of the Exposition, and we had no chance to get inside and adjust the piston rings and bring the piston up to place. With that one exception I know of no reason why the horizontal engines have not done as good work as the vertical in the Intramural station. I say this with due regard to the vertical engine. I believe in the vertical engine because it occupies less floor space and gives an engineer who designs a station a chance to make a better looking and more compact plant, and which will require a smaller real estate investment. The greatest drawback to the adoption of these engines is their first cost. If an engineer is given full power to propose what style of engine is to be used he will, in most cases, suggest the vertical; but this is generally found to be too expensive, and he is compelled to go back to the horizontal. We have been in the habit of installing engines having a rated capacity of from 20% to 25% more power than the rated power of the generator. In my judgment, that is a mistake. The records of the operation of the Intramural Railway this summer, and observations of other plants which I have built, prove to me that when the engine is of about the same rated capacity as the generator or exactly the same rated capacity we get the best economy, for the following reasons: An electric railway engine, as heretofore installed, is normally an underloaded engine, for we have believed that we should have the large engine behind the generator in order to respond promptly to the overload which is liable to occur at any moment. This overload, which occurs at intervals, is supposed to be greater than the rated capacity of the generator, and if it exceeds this capacity the circuit breaker opens and releases the entire machine of its load. As these overloads are intermittent and of short duration, we run our engines below their normal capacity the most of the time in order to be ready for the short, excessive loads, and as these overloads are of short duration I believe it to be better engineering to allow the engine to work uneconomically during these periods by allowing the steam to follow the pistons a longer time, even to full stroke if necessary, for a few revolutions, until the overload ceases, then dropping back to its normal point of cut-off and operating at this point during the long intervals between overloads. If the generator is properly designed it is capable of standing a short overload of 40%, and by strengthening the frames and main working parts of the engine it will easily give 50% more than its rated capacity, thus being able to stand the shocks of short circuits and overloads without damage. I have never seen an engine regulated within 1% on the extraordinary fluctuations of load that railway work gives, although there are many well regulated engines on the market. At a test made in the Intramural Railway station, the vertical engine, with its direct-coupled generators, pulled a load of 12 trains of four cars each, and ran 400 amperes of current into a water rheostat, developing as high as 1,700 HP. for a long period of time. I would like to see the day when power stations will be kept up to the average of the first 30 days, when the expert is in charge. The greatest difficulty is in getting competent men for the wages usually paid by railway companies for this class of work. The sizes of the engines in the power station of the Intramural Railway are as follows: The large Allis compound engine, rated at 200 HP., coupled direct to a General Electric Co. 1,500-K-W. generator. This engine has never been loaded to anywhere near its economical load, except on a test where a water rheostat was used. There is a 300-HP. McIntosh &

Seymour engine and direct-coupled generators for running lights on the battleship and other small work. There is one 600-HP. Allis engine and one 750-HP. Green engine; and these two together operate the road. These are the tandem engines; one in either end of the building. The Green engine drove the road alone, operating six trains for the first six weeks without a hitch, on account of the other engines not being ready, owing to some of the parts of the plant not having arrived. The reason that the vertical engine was operated so long on the road was that it was the unit in the station nearest adapted to the requirements of the road. That vertical engine and generator operated the road for six weeks without any relay, because it took less fuel to run it. The other engines were ready to go, but it was not necessary to start them, owing to the engine doing its work satisfactorily and not requiring any repairs. I do not attribute that to the fact that the engine is the best for railway work, but to the fact that it is of exactly the rated size to fit this particular load.

Mr. Browning, Camden: Have you in that plant such an abundance of power that you never allow an engine to get up to its straining point? As soon as you find it is becoming overloaded, you put more power on; in other words, you have engines and generators with plenty of excess power to fall back on. In ordinary power houses we work our engines up to the full capacity, and a little over.

Mr. Arnold: We have now an excess of power; but for the first six weeks we had only one engine, which was much overworked during this time. The tandem engines work with economy and without straining when both are running. The vertical engine, however, has been strained to an extraordinary degree. It operated the road on July 4, and developed at times as high as 1,700-HP. for several minutes at a time, although its average load was much less than this. The engines slowed down until the governor was on the shaft, but it hung to it, and operated the road very satisfactorily. As to the relative economy between the engines, I do not wish to say much on that subject, because we do not wish to do injustice to anyone. The tests were made at the request of the General Electric Co., and it would be a breach of courtesy on my part to give the results until authorized by it. I do not, however, see any difference in economy between the horizontal and the vertical engines, if both were working under equal conditions. The difference between the Corliss and the high-speed type is very slight. The vertical engine runs 100 revolutions; one of the Corliss runs 90, and the Green 100; all nearly the same speed. I am of the opinion that we will come to a speed of about 100 to 125 turns in all of our engines, and will stay there. I do not believe in the extremely high-speed reciprocating engine.

Mr. O. T. Crosby being called upon to give his opinion of the relative conditions of the power required in generator and the engine, said: The question is in regard to the proper proportion to be established between the rated capacity of dynamos and engines. I have used the term rated capacity, because I know that the discussion, as far as it has gone, was based upon the proportions between rated capacity. As a matter of fact, what we want to get at, I fancy, is the ratio between the real capacity of engines and dynamos. We certainly, in the earlier years of our experience, were met with this difficulty, aside from the one which will always be open as a matter of engineering discussion, namely, that we do not have a correct and understood system of rating as between different makes of generators even, and certainly not between generators and engines. The ratings of electrical machines for railway use in the earlier days of the business were less conservative than they are today. There has been, however, a gradual approach to conservatism in this matter, so that to-day it is not far out of the way, in speaking of a 500-HP. engine and a 500-HP. dynamo, to feel that we are talking about pretty nearly the same thing. I mean that a 500-HP. dynamo should be, and ordinarily is, a machine which can do 500 HP. work steadfastly for 24 hours a day, without either in its bearings or in its electrical parts attaining such a temperature as will permanently injure them in any way, loosen its parts, or do any permanent injury.

I have believed for some time that the best practice is that an engine should be at least no greater in capacity than the dynamo to which it is attached. The engine will certainly not do its work as economically if it be run ordinarily at a considerably lower output than the output for which it has been calculated as a normal output. The dynamo does not suffer by any means so badly in thus being brought below its rated work. If, therefore, an engine of 600 HP. be attached to a dynamo of 500 HP., the man running the station will ordinarily, and very properly, limit the load which is thrown on the couple, since they now constitute a couple, below the capacity, as he understands it, of the dynamo, rather than of the engine. He will endeavor to keep within safe limits with respect to his dynamo. In thus keeping within safe limits with respect to his dynamo, he is keeping too far under the limit with respect to the engine, for economical work. The dynamo is not what you should have unless it can be run at its rated load without any injury. If, at the same time, you are running the engine at about its rated load, you are getting perfectly satisfactory results in both cases as to repair, and the best results in both cases as to the efficiency of output, and that is probably the largest question involved in the whole matter. I have had some conversation with engineers, both in the field in which I am interested and those in charge of power stations, and I find that this opinion is becoming quite well fixed—that the generator and engine should be at least equal, with some in favor of having an engine slightly lower rated in rated capacity than the dynamo. I am told by a representative of a large firm of engine makers in this city that most of the complaints that they receive from their customers are due to the fact that they were running the engines at lower than their proper load.

There is another point as between vertical and horizontal engines. I do not think the matter, as far as it went, was presented just as it seems to me it should have been. There is no difference in the machines, intrinsically, as to their value. You can make a splendid vertical engine, and you can make a splendid horizontal engine. No doubt some of my hearers will think me a "mugwump" on this question; it is impossible to speak on these subjects with as much definiteness and emphasis as many would like; but you can take a particular case and work it out to a greater degree of accuracy than you suppose. A vertical engine, as compared with a horizontal engine, involves a difference in the space occupied; and space represents money, investment; and there, in my opinion, is the meat of the whole question. There is enough experience in the engineering practice to justify us in feeling that vertical engines and horizontal engines are almost equal in value and driving power. Speaking for the electric side, it is a matter of indifference to the generator how it is driven. You want to consider in the most careful way the cost of all these elements in your plant; the engine complete with all its appurtenances, and the space occupied and the economy of its operation. If you approach the question in the broadest way, I believe you may be inevitably led to the use of a vertical engine on real estate considerations, more than any other. I believe that the real estate consideration, the price per square foot of your building, is the determining element in large plants, as to which of the two types is the best to use. It is largely the same question which usually determines as between the condensing and the non-condensing engine. It still remains that the condensing process saves just so much coal, but may cost just so much extra investment. I heard it stated the other day, by a competent engineer, that the condensing process, when coal is in the neighborhood of $3 a ton, may justify an investment of $100 per horse power to bring it about. The analogy between the cases of condensing and non-condensing engines, and between vertical and horizontal engines, is very close. You can get an excellent plant either way.

We are now all very much interested in the large direct-coupled work which we see about us; certainly none more so than those who have built the plants. At the same time I should not want any one to feel that a belted station is not entirely a satisfactory plant. I believe heartily it is. I believe, in that case, as in others, you want to consider your original cost of all the elements. It is simple arithmetic in all these matters throughout. It is quite impossible, in my opinion, to make any generalization, and say, once for all, that a direct coupled generator, or a vertical engine, or a condensing engine is the best. It is all a matter of first cost and investment. These things will all adjust themselves, and in one city you will have one type and in another city another type. You will put in the plant that style of equipment which is directed by the particular conditions of the plant. That is the true generalization.

The location of the station is always an important matter, especially as to the cost of conductors and the question of condensing engines. In the case of a man who is in a city with a river running through it, in such shape that he can put his station near it, he will be at once led to the condensing engine. The manner of placing the conductors is also important; there is a big difference in the case when you have to put your conductors under ground, as compared with the result you will get by putting your conductors overhead. There is an element which is new, to a number of engineers connected with street railway problems, namely, that it costs so much per running foot to lay the conduit itself, independent of the amount of copper.

I do not know that there are any others than the points that I have mentioned which are large elements that come into the matter, but if there is anything that I have not mentioned—and it may well be—I will just say in closing, that everything which goes into your original investment account must be taken into consideration before you decide what is the most economical system of engine with respect to form, etc.

THE TRANS-SIBERIAN RAILWAY.

The Construction of the Trans-Siberian railway is under the control of a committee presided over by the Heir Apparent of Russia, and is made up of the Ministers of War, Marine, Finances and Way and Communications, and of the Imperial Controller. All matter relating to this line will be under the immediate control and supervision of this committee, and it decided some time ago to construct the main trunk consecutively in three stages. These stages are given in detail in a late issue of "Herapath's Journal" as follows:

The first, or Western Siberian, section will extend from Tcheliabinsk to the River Obi, a length of 1,328 versts (885 miles), thence to the town of Irkutsk, a distance of 1,754 versts (1,169 miles). Simultaneously with the building of this portion of the line, the work now in progress on the Vladivostock-Grafsky section will be continued and the construction of a line connecting the Ural mining and Siberian trunk line with Ekaterinburg will be commenced. This portion of the work is to be completed not later than 1900.

The second stage of the work will consist in the construction of the portions of the projected line which extend from Grafsky to Habarovka, 292 versts (195 miles), and from the station of Mysovski, the starting point of the railway on the other side of the Baikal Lake to Stretinsk, a distance of about 1,009 versts (673 miles).

In the third and final stage will be constructed the Circum-Baikal portion, 292 versts (195 miles), and the section from Stretinsk to Habarovka, a length of about 2,000 versts (1,333 miles).

In this manner the trunk Siberian line starting from Tcheliabinsk and terminating at Habarovka will extend over a length of about 6,730 versts (4,487 miles). The cost of the construction of the first section of the line is estmated at £15,000,000 ($75,000,000), this sum including the cost of connection with the Ekaterinburg line. The money assigned will be paid yearly in sums not exceeding £4,000,000.

In connection with the Siberian Ry. it is interesting to note that the sea route to the Yenissei, the pioneer of which was an enterprising Englishman, Captain Wiggins, will be utilized for the purpose of conveying along it railway materials for the new line. These materials will be carried by vessels starting from Russian ports to the mouth of the Yenissei, from which point they will be transported to Krasnoyarsk in barges towed by powerful tugs. Two vessels of the latter description have already been ordered in England, and were to be ready for delivery to the Russian government in July, 1893.

NOTES FROM RECENT WATER-WORKS REPORTS.

The average daily per capita water consumption in Boston has been creeping up for a number of years until for the year ending Jan. 31, 1893, it reached 95.3 gallons on the Sudbury and Cochituate and 78.6 gallons on the Mystic system, against 80.3 and 68.7 gallons only three years ago. A rigid system of inspection is maintained and a goodly number of meters are used or the consumption would doubtless run much higher.

At the Chestnut Hill pumping station the weekly examinations of all the Boston waters are made under the direction of Mr. Desmond Fitz Gerald, M. Am. Soc. C. E., with Mr. E. C. Whipple assistant in charge of the laboratory. The filtration of water is also being studied in detail both here and elsewhere in connection with the works, and Mr. F. L. Hollis has made some extended studies of the colors of the Boston waters with reference to the presence of iron, his report on this subject being given in the last report of the Boston Water Board. It has been found that the color of Boston water is due almost wholly to carbonaceous matter and not to iron. There is embodied in the report of City Engineer Wm. Jackson, M. Am. Soc. C. E., a report by Mr. Dexter Brackett, M. Am. Soc. C. E., on the fire protection facilities afforded by some of the larger cities of the United States, which shows that Boston ranks high in this respect. This report is accompanied by tables and maps, and is a valuable contribution to the knowledge of the subject investigated. In our issue of June 16, 1892, we gave some of the results of Mr. Bracketts' tour of inspection as detailed by him before the New England Water-Works Association. The last report of the water commissioners, of New London, Conn., gives the results of some investigations for a new supply, accompanied by maps. The average daily consumption per inhabitant for the year was 78.7 gallons and per consumer, 87.1 gallons. Mr. W. G. Richards was superintendent of the works.

Meters are to be largely if not wholly used at Albany, N. Y., according to the last report of the water department, the consumption having run up 162 gallons per capita. The report contains a good deal of matter regarding a proposed new supply and also a large map to illustrate the same.

An interesting table showing by percentages the distribution to various accounts of the cost of operating the water-works of Troy, N. Y., for the past twelve years is given in the report for 1892-3 and is reprinted herewith. The unusual cost of repairs in 1884 and 1885 was due to the resetting of the boilers. About two-thirds of the water supplied in 1892 was pumped, against an average static head of 231 and dynamic head of 242 ft. Edw. Dolan is superintendent.

The revenue derived from metered and unmetered water and the cost of supplying water during 1892 at Yonkers, N. Y., is set forth in an instructive manner in the last report of Mr. J. A. Lockwood, Superintendent. The total amount of water pumped during the year was 108,737,000 cu. ft., of which 67,394,00 cu. ft., or about 62%, was metered. The cost per 100 cu. ft. of water supplied was 1.26 cts. for pumping alone; 2.66 cts. to pump and distribute; 9.17 cts. to pump, distribute and pay interest and amount due the sinking fund. For all water pumped the receipts averaged 9.14 cts. per 100 cu. ft.; for all water metered, 11.45 cts., exclusive of that supplied New York city under a special contract of 13 cts.; for metered water under domestic rates, 21.46 cts., and under special rates, 5.84 cts.

The quantity of water furnished and the receipts under the different meter rates were as follows, the last two columns, comparing the percentages which the amount of water at various rates and the revenue therefrom bear to their corresponding totals, having been added for convenience:

Water, cu. ft.	Rate per ft., cts.	Revenue,	Percentages to total. Water.	Percentages to total. Revenue.
308,765*	..	$1,082*	0.5	1.4
12,199,054	25	30,498	18.0	39.5
4,599,017	20	9,198	6.8	12.0
2,429,991	18	4,374	3.6	5.7
2,372,305	15	3,558	3.5	4.6
1,631,887	14	2,289	2.4	3.0
672,899	13	875	1.0	1.1
1,832,488	12	2,199	2.7	2.8
681,886	10	682	1.0	0.9
8,085,703	8	6,469	12.0	8.4
5,591,965	7	3,914	8.3	5.1
4,336,008	6	2,602	6.4	3.4
3,291,925	5	1,646	4.9	2.1
19,492,135	4	7,797	28.9	10 0
67,394,089	11.45 av.	77,183	100.0	100.0

The last two columns show that a very small percentage, 0.5%, of the water used is in such small quantities as to come within the minimum amount charged for. It will also be seen that 18% of the water supplied yields 39.5% of the total revenue, on the basis of the highest meter rate, and that only 10% of the total revenue is derived from water supplied at the lowest rate, although 28.9% of the total consumption is paid for at this rate.

Those interested in water rates charged in various cities throughout the country will find the rates charged for sundry purposes in 20 cities in the last report of the works at Erie, Pa. The rates given are for: Family charge, pan water closet, self-closing urinal, bath tub, self-closing wash basin faucet, set wash tub, two horses, one cow, street sprinkler and total. Most of the works included are owned by the town in which they are located. The totals range from $37.50 in Utica (charge for wash tub not included) and $37.25 in Boston to $21.75 in Chicago. The range of meter rates in about 150 cities is also given in the same report.**

and the results of a number of chemical and biological water analyses.

Three artesian wells furnish the domestic water supply of Clinton and Lyons, Ia., said to have a combined population of over 27,000 (actually 19,418 in 1890). The size, depth and rated capacity of these wells, as given in the last report of the city officers of Clinton, are as follows:

No.	Diam. of bore.	Depth.	Daily flow.
1	8	1,450	700,000
2	5	1,235	400,000
3	8	1,675	900,000
Total flow			2,000,000

The wells are within a radius of 200 ft. and it is said that their flow and pressure seem to remain constant. The 5-in. well was sunk in 1886, when water from it would rise in a tube to a height of 68 ft. above low water in the Mississippi River.

Cost of Operating the Water-Works at Troy, N. Y., for Each of the Twelve years, 1881 to 1892, Inclusive, Distributed by Percentages to Various Accounts.

	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	Mean.	Max.	Min.
Fuel	53.6	48.1	53.6	39.0	30.0	28.7	41 1	36.8	37.3	30.8	37.0	37 6	40.3	53.6	30.0
Labor	24.9	32.0	28.7	23.6	31.0	38.0	37.2	34.3	38 9	43 5	35.4	38.1	33.8	43.5	23.6
Supples	7.9	6.0	5.7	2.6	3.8	4.8	3.4	2.7	3.8	2.7	3.8	2.7	4.3	7.9	2.6
Sup'ntend'ce	5.4	3.8	4.3	3.0	3.8	4.5	4.7	4.1	4.8	5.4	4.3	3.7	4.3	5.4	3.0
Repairs	5.0	7 5	4.7	29.0	27.8	10.6	10.7	19.4	12.3	14.9	16.8	15.1	14.5	29.0	4.7
Gas	2.0	2.0	1.8	2 4	2.2	2.0	2.5	2.2	2.4	2.2	2.3	2.5	2.2	2.5	1.8
Telephone	1.2	0.6	1.2	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.3	0.6	1.2	0.3
Total cost. 1 = $1,000	18.5	15.2	19.0	30.9	26.2	21.2	21.7	24.1	21.0	18.8	23.3	26.0	22.1	31.0	15.2

The works are controlled by the American Water-Works & Guarantee Co., Ltd., of Pittsburg, Pa., and Mr. S. M. Highlands, Clinton, is superintendent. Water may be pumped from the river in case of emergency.

The increase in the number of families taking water and in the number of the various fixtures to which water is supplied is given in the last report of the water-works of Norwich, Conn., of which Mr. E. P. Gardner is superintendent and Mr. Edwin P. Lathrop is cashier. The number of families supplied was 1,376 in 1875 and 3,782 in 1893. Motors were first used in 1887, since which the number has increased from 5 to 29, and elevators in 1888, of which there have been only three until 1893, when one was added. At the time of the report there were in use 324 street and front sprinklers, 349 garden hydrants, 23 jet and spray fountains, and in addtion 27 graperies and greenhouses were supplied with water. The population of Norwich in 1890 was 16,156.

WEATHER TABLE FOR SEPTEMBER, 1893. [Furnished to Engineering News by the Department of Agriculture.]

	Stations.	Temperature. (Deg. Fahr.) Average	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average	Max.	Direction at time of max. velocity.	Precipitation—rain and melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.†
Northern Cities.	Northfield, Vt	51.8	76	27	49	8.0	36	N	1.91	0.60	13
	Portland, Me	55.8	74	39	35	7.7	31	SE	2.33	0.80	15
	New York, N. Y	64.4	84	45	39	9.6	30	NW	2.27	1.04	12
	Pittsburg, Pa	65.3	88	35	53	6.4	22	NW	1.86	0.72	8
	Chicago, Ill	64.1	95	39	56	18.9	60	SE	1.98	0.95	9
	Omaha, Neb	68.5	93	34	59	7.0	25	NW	1.70	1.64*	3
	St. Paul, Minn	61.8	94	31	63	7.8	36	NW	2.70	1.06	5
	Duluth, Minn	56.4	85	30	55	7.1	26	N	1.04	0.82	5
	Bismarck, N. Dak	59.7	96	19	77	12.2	40	NW	0.18	0.09	4
	Average	60.9	87	33	54	9.4	34	NW	1.77	.86	
Southern Cities.	Washington, D. C	66.0	88	42	46	5.3	30	NW	3.91	1.00	9
	Louisville, Ky	71.8	95	44	51	6.0	26	N	4.00	1.12	9
	St. Louis, Mo	72.6	99	44	55	10.2	33	S	3.69	1.34	8
	Savannah, Ga	78.1	97	59	38	6.3	26	NE	8.29	4.35	8
	Leavenworth, Kan	70.5	100	40	60	7.8	45	S	4.62	2.31	9
	Jacksonville, Fla	78.9	96	61	35	6.2	26	E	6.09	2.13	11
	Chattanooga, Tenn	71.8	95	48	47	5.4	31	SE	2.19	0.70	12
	New Orleans, La	79.8	95	66	29	8.1	36	NE	4.38	1.98	11
	Memphis, Tenn	73.0	94	46	48	6.7	32	SE	5.46	2.55	8
	Palestine, Tex	78.8	100	57	43	6.1	25	SE	1.32	1.32	2
	Average	74.1	96	51	45	6.8	31	SE	4.40	1.88	
Western Cities.	Helena, Mont	54.4	90	30	60	7.0	38	SW	2.69	1.63	13
	Port Angeles, Wash	52.4	77	38	39	4.5	20	W	0.85	0.35	9
	San Francisco, Cal	59.3	72	50	22	12.6	35	SW	0.21	0.12	3
	Salt Lake City, Utah	63.0	86	33	53	6.9	36	NW	1.30	0.80	3
	Santa Fé, N. Mex	59.8	79	42	37	5.9	32	SE	3.00	1.70	10
	Denver, Colo	63.4	89	35	54	6.4	30	NE	0.05	0.03	2
	Yuma, Ariz	81.6	107	54	53	5.7	29	SE	0.08	0.08	2
	Average	62.0	86	40	45	7,0	31	SE and NW	1.17	0.67	

*On the 28th and 29th.

†.01 of an inch or more falling each day.

Corporations for the removal of the World's Fair buildings are being rapidly organized in Chicago. The Chicago House Wrecking Co. has offered to remove the Manufactures, Government, Electricity, Transportation, Machinery and Fisheries buildings for $90,000 and such material as it can save, asking a year's time in which to do the work. The company is said to have already closed contracts for removing many of the state buildings. Another corporation with $1,000,000 capital has been organized to buy the Manufactures and some of the other large buildings, remove them to unimproved land near Jackson Park, and re-erect them as a private enterprise.

A 75-ton concrete tipping box is described in "Engineering" of Oct. 6, as used in building the La Guira breakwater. This box, 32 × 7½ ft., and 5 ft. 4½ ins. deep, was made of rolled iron sections and lined with 2½ in. elm. It rested upon rockers on a framework carried by eighteen 12-in. wheels. The front side of the box was a door hinged at the top and held at the bottom by four bolts operated at once by a lever back of the truck. Though the description is not full in this respect, the purpose evidently was to deposit the 75 tons of concrete in a huge sailcloth bag inside this box, and the box was then run out on the six lines of rails; was tipped and the door opened at the same time, and the bag of concrete then rolled and sank into place on the breakwater.

The height of Mt. St. Elias is fixed at 18,010 ft. by the U. S. Coast and Geodetic Survey, and is so announced by Dr. Mendenhall, in a paper recently read before the National Geographical Society, of Washington. The observations were numerous and satisfactory and the methods were above criticism. The summit of Mt. St. Elias was determined by Messrs. J. E. McGrath and J. H. Turner, to be in 60° 17′ 35″ north latitude, and 140° 55′ 21½″ west longitude, nearly five miles inside the Canadian boundary. If the trigonometrical observations made in 1892 by Dr. J. T. Scoville are correct, Orizaba, in Mexico, has a height of 18,314 ft., thus overtopping Mt. St. Elias by 300 ft.

The complete table of sixteenth century measurements is as follows, says the London "Architect": The breadth (not the length, as is particularly stated) of four barley corns make a digit, or finger-breadth; four digits make a palm (measured across the middle joints of the fingers); four palms are one foot; a foot and a half is a cubit; ten palms, or two feet and a half, are a step (gressus); two steps, or five feet, are a pace (passus); ten feet are a perch; 125 paces are an Italic stadium; eight stadia, or 1,000 paces, are an Italic mile; four Italic miles are a German mile; and five Italic miles are a Swiss mile. It will appear most probable from the preceding statement that the foot was considerably less even than the ancient Roman foot of 11.6 English inches; the average human foot certainly has not that length. The table just mentioned, derived from the Romans in most of its parts, is founded upon a notion which is very near the truth in a well proportioned man, namely, that the breadth of the palm is the 24th part of the height; the length of the foot, the sixth; and the length of the cubit, or from the elbow to the ends of the extended fingers, the fourth.

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*These figures represent the totals for consumers using so little water that at meter rates it would fall below the minimum charge for supplying one house or family; the actual rate is about 35 cts.

** In Engineering News of Aug. 9 and 16, 1890, averages of the family and meter water rates charged in about 750 cities were given, the figures being arranged by states and groups of states and by private and public ownership. These figures, together with the corresponding figures for the 750 cities, upon which the tables were based, were also published in the Manual of American Water-Works for 1889-90.

Some hemlock ties, treated by the burnettizing or zinc chloride process, have been in service 20 to 24 years on the Chicago, Rock Island & Pacific R. R. In 1866 the chief engineer, Mr. E. H. Johnson, had 1,000 ties treated by the American Bridge Co., which had a plant for burnettizing timber for Howe truss bridges. These ties were laid near Englewood, Ill.; 600 of them were still in the track in 1885, and the last were not renewed until 1890. It is stated that these ties did not decay, but were renewed on account of wear by the rails.

According to press accounts the cutting away of the forests of Aroostook County, Me., has so reduced the water storing capacity of the soil that the old-time shallow wells no longer furnish a supply, and the farmers are now resorting to artesian wells driven through the rock strata underlying the soil. It is also said that the climate has become so dry that irrigation of farms is being discussed, with water obtained from deep artesian wells.

The approximate cost of a 120 × 75 ft. brush mattress, as used at St. Augustine and in the St. Johns River, Florida, is 61⅓ cts. per sq. yd., says Capt. Wm. M. Black, Engineer Corps, U. S. A., in his paper on "Improvement of Harbors," presented to the International Engineering Congress, at the Columbian Exposition. The contract price for log and brush mattresses in place varied at the same places from 54 to 75 cts. per sq. yd. Brush fascine mattresses cost, by contract, from 70 to 74 cts. per sq. yd.

A wood pipe line of Washington fir has recently been tested at Anacortes, Wash., with satisfactory results. The pipe is 14 ins. in diameter, and about 6,000 ft. long, and forms an extension to the Ace of Hearts Lake, of the old supply pipe consisting of 12,000 ft. of steel spiral-weld pipe. The extension was made necessary on account of a decrease in the flow of the springs upon which dependence was formerly had.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BANGOR & AROOSTOOK.—The track on this railway in Maine was laid to within four miles of the East Branch of the Penobscot River, Oct. 19, and was expected to reach Grindstone last Saturday. The grading is practically completed from Brownville to Houlton.

CANADIAN PACIFIC.—It is reported that over 300 men are at work on the Lake Temiscamingue Colonization R. R. The road is to be completed to the head of Lake Temiscamingue, Que., by June 10, 1896, as stated in our issue of Aug. 24, and is already in operation from Mattawa, Ont., north to Lake Kippewa, Que., a distance of 15.5 miles.

LANCASTER, OXFORD & SOUTHERN.—W. M. Franklin, Lancaster, Pa., president of this company, has issued a letter to the bondholders of the Lancaster & Quarryville R. R., proposing an alliance of the two roads, and traffic arrangements with the Reading and Baltimore & Ohio, according to reports. A line will be completed from Lancaster to connect with the Baltimore & Ohio, at some place between Philadelphia and Baltimore.

OTTAWA & GATINEAU VALLEY.—It is stated that Pickanock, 54 miles from Ottawa, will be the terminus of this road for this winter. The tracklaying has reached 5½ miles above Kazubazua, Que., having about four miles more to be laid this fall. The line was completed from Hull (near Ottawa) to Kazubazua, 45 miles, several months ago, and has been surveyed as far north as River Desert, a distance of 85 miles.

OTTAWA, ARNPRIOR & PARRY SOUND.—About 800 men are at work on this railway, according to reports. The rails have been laid three miles west of Arnprior, and the grading will be completed to Golden Lake, 84 miles from Ottawa, by the middle of next month. The route for next season's construction has been located. Ch. Engr., G. A. Mountain, Ottawa.

PENNSYLVANIA—It is expected that tracklaying on the branch from Angora, Pa., to Newton Square, a distance of about 10 miles, will be commenced in December. The road is to be completed July 1, 1894.

SOUTH JERSEY.—It is reported that the extension of this road to Cape May will be resumed early in the spring. The line is partly graded. Gen. Man., Jas. E. Taylor, Bullit Bldg., Philadelphia.

TOBIQUE VALLEY.—Regular trains will be started on this railway Nov. 1, according to reports. The road extends from Perth Centre, N. B., on the Canadian Pacific Ry., to Plaster Rock, a distance of 28 miles, and has been leased by the Canadian Pacific.

Projects and Surveys.

HARRISBURG & DELAWARE RIVER.—This railway is projected from Harrisburg, Pa., to Portland, in the northeastern part of the same state. It would be about 107 miles long, and an extension to Newburgh, N. Y., to connect with the New York & New England R. R., is also proposed. Ch. Engr., R. Albert, Trenton, N. J.

MENOMINEE & NORTHERN.—Press reports state that this company has been organized at Menominee. Mich., with a capital stock of $500,000, to build a railway from that city northwest to the iron range and through the lumber districts, a distance of 55 or 60 miles. A survey is being made on the Wisconsin side of the river down to a point where a suitable crossing can be effected, and a terminal will be made in Menominee for the necessary ore docks, where shops will also be located. As soon as the surveys are completed construction is expected to be commenced. A portion of the Ingalls, White Rapids & Northern R. R. will be utilized for the new road.

NEW YORK.—It is reported that a syndicate has been formed to build a railway next spring from near Saranac Lake, N. Y., to the top of White Face Mountain, a distance of about 13 miles.

Southern—Existing Roads.

JELLICO, BIRD EYE & NORTHERN.—It is reported that extensions are contemplated in order to reach more extensively the property of the Jellico & Bird Eye Coal Co. The present line is 7½ miles long. Pres., E. T. Halsey, Louisville, Ky.

MONTGOMERY, MEMPHIS & ST. LOUIS.—The Montgomery, Tuscaloosa & Memphis and the Tuscaloosa Northern railway companies have reorganized under this name. The new road will have as its termini Montgomery, Ala., and Columbus, Miss., and will be built through Tuscaloosa. It is intended to connect the M. & O. and Plant System. Branches will also be built into the Alabama coalfields. Most of the grading between Montgomery and Tuscaloosa has already been done. Pres., C. C. Monroe, New York; First Vice-Pres., E. B. Joseph, Montgomery; Second Vice-Pres., W. C. Jemison, Tuscaloosa; Secy. and Treas., G. B. Shellhorn, Montgomery; Asst. Secy., A. S. Woolfolk, Montgomery.

WELSH COLONY.—This railway, which is being built from the West Virginia & Pittsburg R. R. to Pembro, Webster Co., W. Va., is reported as nearly completed. It is about 15 miles in length and is built in the interest of the Welsh colony organized about five years ago in that county.

Projects and Surveys.

VIRGINIA.—The Detrick Fertilizer & Chemical Co., 28 Chamber of Commerce, Baltimore, Md., will receive bids until Nov. 6 for grading and constructing three miles of narrow gage railway at Alexandria, Va.

Northwest—Existing Roads.

CHICAGO & NORTHWESTERN.—The Palmyra, Wis., correspondent of the Milwaukee "Sentinel" states that this company has been making surveys for a branch line passing through Whitewater, Hebron, Rome and Oconomowoc, and that the construction of the road will soon be commenced.

RICE LAKE, DALLAS & MENOMINEE.—The construction of this proposed road between Rice Lake, Louisburg and Dallas, Wis., a distance of 20 miles, is reported to have been commenced. Secy., J. E. Horseman, Rice Lake, Wis.

Projects and Surveys.

LAKE SHORE, RIVERVIEW & ELGIN.—Incorporated in Illinois to build a railway from a point on Lake Michigan between Rogers Park and Evanston to Riverview, on the Wisconsin Central Ry., and thence to Elgin; capital stock, $1,000,000; Pres., D. W. Wood, Park Ridge; Secy., Isadore Price, Chicago; Treas., T. H. Coleman, Rogers Park; Right of Way Agent, Thos. Jones, Park Ridge.

SIOUX CITY, CHICAGO & BALTIMORE.—Press reports state that the officers of this company, which proposed to build a railway from Sioux City, Ia., to Hannibal, Mo., have abandoned the project and released the tax amounting to $480,000 voted by Sioux City to aid the enterprise.

WISCONSIN & MICHIGAN.—Incorporated in Wisconsin to build a railway through Marinette county from Marinette to the Michigan state line; capital stock, $1,500,000; John Bagley, Chicago; B. J. Brown, Edward Daniel, Menominee, Mich.; J. A. Van Cleve, Marinette, Wis. This is probably the same company referred to above as the Menominee & Northern.

Southwest—Existing Roads.

ATCHISON, TOPEKA & SANTA FE.—An official of the Gulf, Colorado & Santa Fe Ry. is reported as stating that probably an extension will soon be built from Morgan, Valley Mills or Meridian to Waco, Tex.

MISSOURI, KANSAS & TEXAS.—It is stated at San Antonio, Tex., that active work will soon be commenced on an extension of this railway from San Marcos to that city, a distance of about 50 miles. The new line would shorten the distance between San Antonio and Houston 14 miles and give the former city another direct railway to Northern Texas places.

Rocky Mt. and Pacific—Existing Roads.

OREGON PACIFIC.—Press reports from Corvallis, Ore., state that Judge Fullerton, of the circuit court, has issued an order directing an unrestricted sale of the property of this railway company by the sheriff on or before Dec. 15. The road is projected to extend from Yaquina, Ore., to Boise City, Idaho, 600 miles, of which about 142 miles, from Yaquina to Boulder Creek, Ore., were completed in 1890. The company also operates a line of steamboats on the Willamette River, between Portland and Corvallis, but has been in the hands of a receiver since Oct. 28, 1890. Several attempts have already been made this year to sell the road but no bids have yet been received. Receiver, E. W. Hadley, Corvallis, Ore.

Projects and Surveys.

BODIE RY. & LUMBER CO.—Incorporated in California to build a railway 30 miles long in Mono county and to engage in the lumber business; capital stock, $200,000; already subscribed, $34,000, of which $33,500 is by Wm. J. Menzies, Edinburgh, Scotland; Thos. Menzies, San Rafael; Chas. P. Eells, W. S. Wood, E. L. Reese, R. H. Floyd, San Francisco.

OVERTON.—Press reports from Pueblo, Colo., state that the Rocky Mountain Oil Co. will soon build this railway, two miles in length, to connect with the Denver & Rio Grande R. R. at Eden, Colo. The route was surveyed last week.

STREET RAILWAYS.

BRUNSWICK, ME.—The franchise for building an electric railway in this city and Topsham has been sold to the Bath St. Ry. Co., and it is intended in the spring to extend the Bath road to this place and to Cape Small Point and Popham.

NEWTON, MASS.—The Newton & Cochituate St. Ry. Co. has been formed in this city to take the franchise abandoned by the Newton & Wellesley St. Ry. Co., and construct a line from West Newton through Wellesley and South Natick, to connect with the Natick & Cochituate Ry. The right to build an electric railway through Wellesley and South Natick has already been obtained, and a petition is soon to be presented asking for a location over Washington St. in this city. If the necessary concessions can be obtained it is proposed to commence work on the new line in the spring. With the completion of this road, the last link in the chain of electric street railways from Boston to South Framingham will be provided.

SYRACUSE, N. Y.—The council has granted important franchises to a syndicate represented by W. R. Kimball. It is stated that continuous rails will be laid.

PLAINFIELD, N. J.—The Plainfield Electric St. Ry. Co. is planning an extension to New Market. Pres., Thos. Nevins, Orange, N. J.

CARBONDALE, PA.—The Carbondale & Dundaff St. Ry. Co. has been incorporated to build a street railway from this city to the Susquehanna Co. line; capital stock, $30,000; Pres., John J. Fahey, Scranton, Pa.

CHESTER, PA.—The Chester & Wilmington Electric Ry. Co. proposes connecting its line with the Union line, at Marcus Hook, and with the Wilmington road at Wilmington. The road will be built as soon as spring opens. About eight miles of road will be constructed and when it is finished there will be a continuous line of electric railways between Wilmington and Chester. An independent power plant will be erected at Marcus Hook.

ERIE, PA.—The mayor has signed the ordinance granting a franchise to the Edinboro & Erie R. R. Co., the construction to be commenced within 60 days and the road completed within a year. The company was chartered Sept. 9 to build an electric railway between this city and Edinboro, but it is thought probable that the line will be extended to Cambridge, Meadville and Titusville; capital stock, $200,000; Pres., G. E. Ryckman, Brocton, N. Y.

FOREST CITY, PA.—The Forest City Electric Ry. Co. has been incorporated to build an electric railway from where a stone bridge crosses the Lackawanna River, in Fell Trop, Lackawanna Co., through the village of Vandling to the Susquehanna Co. line; capital stock, $30,000; Pres., John J. Fahey, Scranton, Pa.

NORRISTOWN, PA.—The Norristown, Bridgeport & Conshohocken Traction Co. proposes to build an electric railway in Montgomery and adjacent counties; capital stock, $10,000; Treas., Edward S. Perot, Yonkers, N. Y.

SCRANTON, PA.—The Scranton & Pittston Traction Co. has been incorporated; capital stock, $1,050,000; Treas., Chas. H. Mullin, Mount Holly Springs, Pa.

SOUTH BETHLEHEM, PA.—The Lehigh Valley Traction Co. has accepted the ordinance granting it the right of way through this place.

BALTIMORE, MD.—The West Baltimore Passenger Ry. Co. has been incorporated to build an electric railway to Relay and probably to Ellicott City; capital stock, $100,000; Wallace Stebbins, H. O. Stebbins, Relay; H. W. Bennett, Baltimore; B. W. Trenton, Findlay, O.——The contract for the construction of the Baltimore City Passenger Ry. Co.'s new electric power house, Light and Heath Sts., has been awarded to S. H. & J. F. Adams.

LYNCHBURG, VA.—R. T. Gleaves has completed surveys for the Rivermont extension, 1¾ miles in length, and the contract for the construction will be awarded at once. Pres., John P. Pettyjohn.

MONROE, MICH.—The Toledo, Monroe & Detroit Electric Ry. Co. has secured the right of way from Toledo, O., to this city and has offered to build a steel bridge to take the place of the Monroe St. bridge provided it is given a franchise on that street, according to reports.

CHICAGO, ILL.—The Chicago City Ry. Co. has petitioned for franchises for two new lines, also for permission to operate all its cars not now drawn by cables with electricity.

PEORIA, ILL.—The council is considering a franchise for an electric railway on Bridge St. from Adams St. to the bridge and thence across the river. This is thought to be the projected electric railway to Pekin.

WHITEFISH BAY, WIS.—The citizens have voted in favor of issuing bonds for an electric railway to Milwaukee, and it is stated that the road will be built in the spring.

LEAVENWORTH, KAN.—Newman Erb, Dwyer, recently appointed receiver of the street railway company, is arranging to change the motive power from horses to electricity. Several franchises have already been granted him and others are being arranged by the council.

WEBB CITY, MO.—E. L. Wallower, of the electric railway company, is reported as stating that it is the intention to build extensions to Carthage, Galena and Baxter Springs, but that the work will not be done at present.

WALLA WALLA, WASH.—The local press is agitating an electric street railway.

LOS ANGELES, CAL.—It is reported that the Cahuenga Valley Dummy R. R. will be extended to Laurel Canyon.

SAN BERNARDINO, CAL.—Wm. H. Burkhart, Pres. of the Nickel-Plate St. Ry. line, has leased the San Bernardino street railway, with the privilege of purchase, and will take possession Nov. 1. It is the intention to extend the line to Arrowhead Springs, five miles distant, and other suburban places and operate it as a dummy road.

PHOENIX, ARIZ.—The contract for an electric street railway through Novinger tract has been awarded to M. H. Sherman, and the construction will be commenced at once.

VICTORIA, B. C.—The National Electric Tramway Co. has authorized a loan of nearly $350,000 for extensions and improvements.

TORONTO, ONT.—The Toronto & Richmond Hill St. Ry. Co. has awarded the contract for the first section of its road to Jas. F. McMahon, St. Catharines.

ELEVATED RAILWAYS.

BROOKLYN, N. Y.—The King's County Elevated R. R. has been granted permission to extend its line along the Eastern Parkway from the present terminus at Montauk Ave. The new extension will be about 15 blocks in length and will turn into Liberty Ave. at Market St. and along that avenue to the city line at Grant Ave. The construction of the extension will be commenced as soon as possible.

HIGHWAYS.

NEW HAMPSHIRE.—The city of Dover is reported to have subscribed the money necessary to secure plans for a proposed boulevard between that city and Durham, and the route will soon be surveyed.

MASSACHUSETTS.—The town of Walpole has appropriated $200 toward the preliminary work of the proposed state highway, and the town of Wrentham will hold a special meeting Oct. 31 to consider the project.

INDIANA.—The commissioners of Greene county will receive bids until Nov. 3 for constructing macadamized and gravel roads. Thos. C. Owen, Co. Aud., Bloomfield, Ind.

BRIDGES AND TUNNELS.

MANCHESTER, N. H.—A new iron bridge has been authorized over the Piscataquog River at South Main St.

BOSTON, MASS.—The city engineer has prepared plans for a tunnel under the Boston & Albany R. R. tracks at Allston. It would be a continuation of Franklin St.

NEW HAVEN, CONN.—The mayor has called a special meeting of the aldermen to consider the immediate repairing of the city's bridges; estimated cost, $100,000.

BUFFALO, N. Y.—The department of public works will receive bids until Nov. 4 for extending and raising the abutments and replacing the superstructure thereon of the bridge on Bailey Ave. over the Scajagnada Creek.

LONG ISLAND CITY, N. Y.—The bridge committee is reported as unanimously in favor of the proposed tunnel under Newtown Creek, referred to in our issue of Oct. 12. A special legislative enactment will be required to authorize the work, which would be paid for in equal shares by Queens and Kings counties; estimated cost, $750,000.

NIAGARA FALLS, N. Y.—E. A. C. Pew, Toronto. Ont., was in the city this week to organize a stock company with a capital of $400,000, to build and operate a bridge across the Niagara gorge, a short distance below the railway suspension bridge. It would be 20 ft. higher than the last named structure and would be used by an electric railway.

SCOTTSVILLE, N. Y.—It is reported that the Western New York & Pennsylvania R. R. Co. will build new iron bridges at this place, Cuylerville, Rossburg and Cuba. Excepting a few small bridges all on the Rochester division will be of iron or steel. Ch. Engr., R. D. McCreary, Buffalo, N. Y.

FRONT ROYAL, VA.—Bids are asked until Nov. 1 for approaches to iron highway bridges, as stated in our advertising columns. H. A. Turner, Engr.; John T. Lovell, Co. Clk.

VICKSBURG, MISS.—The Black Bayou bridge on the Texas & Pacific Ry., between this city and Shreveport, La., has been destroyed by fire.

CLEVELAND, O.—Bids are asked until Nov. 18 for $285,000 of 10-year 5% bridge repair coupon bonds. W. A. Madison, Cy. Aud.

TOLEDO, O.—The contracts for the Western Ave. bridge over the M. & E. canal has been awarded to the Toledo Bridge Co., at $6,093.

RICHMOND, TEX.—The contract for a steel bridge across the Brazos River at this place has been awarded to the Penn Bridge Co., at $20,178, the bridge to be completed by May 12, 1894.

WHARTON, TEX.—Bids are asked until Nov. 13 for a steel bridge across the Colorado River at or near this city. R. F. Bentley, Co. Judge.

WATER-WORKS.

CAPE ELIZABETH, ME.—Press reports state that the owners of the works at this place have issued bonds for $200,000.

SORRENTO, ME.—It is reported that new works will be built. Works were put in by a private company in 1887. L. E. Scruton, Cy. Engr.

MANCHESTER, N. H.—The city has sold $100,000 of 20-year 4½% water bonds for $106,090.

NEWPORT, N. H.—The building of works is being discussed.

BURLINGTON, VT.—Bids are asked until Nov. 4 for the extension of the intake, as stated in our advertising columns. F. H. Crandall, Supt.

CAMBRIDGE, MASS.—Plans are reported as being made for a 40,000,000-gallon reservoir to be built in Belmont.

DALTON, MASS.—An extension of the reservoir is being considered.

DANVERS, MASS.—Preparations are being made for the connection of Swan and Middleton ponds, the pipe to be laid at once.

EASTHAMPTON, MASS.—The town has appropriated $5,000 for new pipe in three streets.

GREENFIELD, MASS.—The commissioners have decided to employ an engineer to report upon an increased supply for another year.

HOLYOKE, MASS.—E. W. McClintock, Boston, has been engaged to examine the plans for the proposed extension of the system to Granville.

LANCASTER, MASS.—The town has appropriated $6,000 for extensions in Harvard St.

QUINCY, MASS.—The mayor has recommended that the question of a supply from Blue Hill River be submitted to a vote of the citizens, in accordance with the legislative enactment.——The board will soon report to the council concerning another reservoir and means for purifying the present one.

WAKEFIELD, MASS.—The question of municipal ownership of works is again being urged.

WEST SPRINGFIELD, MASS.—The $25,000 of water bonds recently voted are being negotiated.

EAST PROVIDENCE, R. I.—Chas. E. Pierce, who was awarded the contract for laying several thousand feet of pipe for the Watchemoket fire district, will soon begin work.

BUFFALO, N. Y.—Jas. Lutted, Chas. Richardson and Dr. N. Osborne, Black Rock, are interested in a company proposing to establish a summer resort on Grand Island, where works would be put in.

PORT JERVIS, N. Y.—At a recent public meeting the village trustees were requested to take action to secure municipal works. The present works were built in 1870 by the Port Jervis Water-Works Co.

ROCHESTER, N. Y.—The city treasurer will sell on Nov. 3 additional water supply bonds for $1,000,000.

JERSEY CITY, N. J.—W. W. Ruggles, Ch. Engr., has reported that it would cost $31,375 to lay 18,950 ft. of 12-in. main from the high service station to Bidwell Ave.

EAST BRADY, PA.—Municipal works are proposed. There are two small, private plants. J. T. Foster, Cy. Engr.

WASHINGTON, D. C.—Land has been purchased for a high service reservoir.

HARRISONBURG, VA.—It is reported that the $18,000 of bonds, recently referred to, will soon be issued for an increased supply.

JACKSONVILLE, FLA.—The citizens have voted, 717 to 212, in favor of bonds for $225,000 for extensions.

KEY WEST, FLA.—It is reported that works are assured in the near future.

GENEVA, ALA.—Works will soon be put in, according to reports.

NEW ORLEANS, LA.—The New Orleans Water Co. will soon make important extensions of the fire mains.

COLUMBIA, TENN.—Bids will be received at the Columbia Arsenal until Nov. 16 for a 120,000-gallon cistern. Capt. John E. Greer, Ord. Dep., U. S. A.

MOUNT STERLING, KY.—It is reported that a franchise has been granted.

BRILLIANT, O.—The council is considering a proposition from the town of Wellsburg, W. Va., for a supply.

CAMBRIDGE, O.—An election will be held Nov. 7 to vote on the proposition for works stated in our issue of Aug. 31.

DAYTON, O.—Bonds for $20,000 have been sold for extensions.

LOCKLAND, O.—The contract for works was recently awarded, but the bond issue has been decided illegal, and it is thought the matter may now be dropped.

TOLEDO, O.—The city is selling $496,000 of water-works refunding bonds.

CORYDON, IND.—Works will soon be put in by a private company; estimated cost, $10,000; address W. T. Zenor.

EVANSVILLE, IND.—Seventeen competitive plans for works were opened Oct. 18, in accordance with the conditions published in our issue of Aug. 3. The estimated cost of the piping system ranged from $50,000 to $150,000, according to the plans, and size of the distributing mains from 16 to 20 ins. Most of the plans are reported to have advised the adoption of a stand-pipe and a system of filtration. The estimated cost of works varied from $184,000 to $983,000. No action will be taken for a couple of weeks.

DETROIT, MICH.—The commissioners will receive bids for about 4,000 tons of pipe for use next year.

GRAND RAPIDS, MICH.—A supply from wells is being considered.

LAKE ANN, MICH.—Works will be put in this winter or next spring, the supply being from wells; estimated cost, $5,000; population, 1,000; C. H. Thomas, Cy Clk.

MARSHALL, MICH.—Steps will be taken to purchase the works, according to reports.

PORT HURON, MICH.—Bids are asked for $10,000 of five-year 6% water bonds.

MARION, IND.—The contract for two steam pumps has been awarded to the Downie Pump Co., Valencia, Pa., at $1,500. The wells are 250 ft. deep, and the working barrel is to be put down 100 ft. The contract for a 35-HP. boiler was awarded to the Piqua Boiler Co., Piqua, O., at $340. About three miles of 4 and 6-in. pipe have been laid this season. H. F. Clank, Clk.

GLENCOE, ILL.—Bids are asked for a distribution system estimated to cost $60,000 to $80,000, the supply to be from the Winnetka mains.

HARLEM, ILL.—The contract for laying water pipe through the grounds of the Old People's Home, has been awarded to the Seckner Contracting Co., Chicago.

KEITHSBURG, ILL.—Harry P. Humbert, Cy. Clk., writes us that the works are about completed.

LADD, ILL.—Bonds for $5,000 for works are reported as having been issued.

MARENGO, ILL.—The contract for works and an electric light plant has been awarded to the Seckner Contracting Co., Chicago, at $34,726.

PORTAGE, WIS.—The special committee has decided to report that the system as at present operated is entirely inadequate. J. C. Britt, Chn. Com.

SOUTH MILWAUKEE, WIS.—No bids have yet been received for the proposed issue of bonds, and the construction of works has accordingly been postponed.

GRINNELL, IA.—J. F. Wilson, Cy. Clk., writes us that the city has an artesian well and has purchased a pump, and that next spring bonds will be sold and works put in to cost about $30,000.

NEBRASKA CITY, NEB.—The city is considering the question of municipal works.

LARAMIE, WYO.—Bids have been opened for $100,000 of bonds for works, for which G. Land, Denver, is preparing plans. The supply will be from the Laramie River, as stated in our issue of Oct. 5.

CLINTON, MO.—The Home Water-Works Co. has been incorporated; capital stock, $28,000; W. L. Crow, E. H. Matthewson, F. E. Potter and others.

OREGON, MO.—Efforts are being made to secure works, according to reports.

ST. JOSEPH, MO.—The water company has been ordered to lay 4,900 ft. of 16-in. and 1,650 ft. of 12-in. main.

ST. LOUIS, MO.—The board of public improvements will receive bids until Nov. 3 for laying 2,200 lin. ft. 6 and 12-in. pipe, etc.

WARRENSBURG, MO.—The council has accepted a proposition of J. H. Christopher to put in works, subject to a vote of the citizens Nov. 4.

BASTROP, TEX.—It is reported that bids will soon be asked for pump, boilers, pipe, etc. The franchise for works has been granted to John Andrewartha, as stated in our issue of Sept. 14.

BROWNWOOD, TEX.—The council is considering putting in a dam at the bayou, 125 ft. long and 5 or 6 ft. high.

DALLAS, TEX.—The council has passed an ordinance providing for the issue of $100,000 of bonds, of which at least $50,000 will probably be spent in improving and extending the works.

HALLETTSVILLE, TEX.—It is reported that the city is about to put in a deep-well pump.

TYLER, TEX.—About five miles of 5-in. mains will be relaid with 15-in. mains, according to reports.

EVERETT, WASH.—The Everett Water Co. has offered to sell its plant to the city for $140,000. The company has been enjoined from taking Woods' Creek for a supply, but the city could acquire it by condemnation.

OAKESDALE, WASH.—Works will probably be put in next spring if the city succeeds in negotiating the proposed bonds.

SEATTLE, WASH.—The city engineer and superintendent have been instructed to ascertain the price of a suitable site on Queen Anne hill for a new tank.

SPOKANE, WASH.—Bids will soon be asked for the new works, the dam estimated to cost about $75,000, race $45,000, and power house $20,000.

DALLAS, ORE.—The citizens will soon vote on a proposed issue of bonds for $14,000 for works.

HILLSBORO, ORE.—H. V. Gates, D. Kankin, H. W. Gates and W. E. Pruyn are interested in the Hillsboro Electric Light & Water Co., recently noted as incorporated.

COLTON, CAL.—The committee has reported that a pipe line would cost the city $24,700.

LOS ANGELES, CAL.—Press reports from San Bernardino state that Frank C. Bolt, Pasadena, has purchased 225 acres of land in the artesian water belt about three miles southwest of that city, and that he represents a syndicate whose purpose is to develop 5,000 inches of artesian water to be conveyed to this city for domestic purposes.

SANTA BARBARA, CAL.—An election will soon be called to vote on the proposed purchase of works, stated in our issue of Sept. 28.

WINNIPEG, MAN.—The Winnipeg Water-Works Co. will meet Oct. 27 to consider a loan of $150,000.

MONTREAL, QUE.—The contract for boilers will be awarded to the Babcock & Wilcox Co., Kinstore, Ont., at $12,751, or to the Heine Foundry, Montreal, at $13,500. The vote was a tie with one alderman absent.

ARTESIAN WELLS.

LITCHFIELD, ILL.—The city has appropriated $1,000 for an artesian well.

BRUCEVILLE, TEX.—The citizens have raised $1,700 for an artesian well.

IRRIGATION.

LOS ANGELES, CAL.—The contract for the proposed work to reclaim the Mojave desert, referred to last week, is reported to have been awarded to C. E. Crowley, of this city. The work is to be commenced at once, and the dam and submerged flume completed by Jan. 1, and the canals by March 1 next. William Duterlo, Los Angeles, is interested.

NEW COMPANIES.—Dodge City Light, Water & Land Co., Dodge City, Kan.; $250,000.——Amizett Tower Co., Santa Fe, N. Mex.; $10,000; J. E. Laconee, B. Martinez, N. Anaya and others of Taos County, and N. B. Laughlin, of this city.

SEWERS.

PORTSMOUTH, N. H.—Plans for a complete system are being prepared, and it is expected that the construction will be commenced early in the spring.

LEOMINSTER, MASS.—The contract for a system has been awarded to Staples Bros., Lowell.

LOWELL, MASS.—An additional loan of $60,000 is being considered. About 500 men are now employed on sewer construction and the appropriation will soon be exhausted.

LYNN, MASS.—The committee has voted to advertise for bids for sewers in several streets.

WOBURN, MASS.—The council has requested the finance committee to raise a loan of $25,000 for sewer construction.

BUFFALO, N. Y.—The department of public works will receive bids until Nov. 8 for four brick and tile sewers.

FAR ROCKAWAY, N. Y.—The commissioners are negotiating for plans for a system, including a sewage disposal plant. Pres., W. W. Jones; Secy., J. J. Mott.

NEWBURGH, N. Y.—The contract for a sewer in West Newburgh has been awarded to M. Sullivan & Co., Little Falls, at $109,054. The total bids were published last week.

ROCHESTER, N. Y.—The city surveyor has completed the plans for the proposed State St. sewer. The sewer will be built of stone, and may be in tunnel, the work to be commenced as soon as possible.——The city treasurer will sell $400,000 of sewer bonds on Nov. 4.

TROY, N. Y.—The contract for a brick sewer in Pine Woods Ave. has been awarded to Peter Darby, at $7,977.

JERSEY CITY, N. J.—Bids are asked until Nov. 6 for 1,865 lin. ft. 34-in. brick oval sewer, and 1,950 lin. ft. 48-in. brick circular sewer. Geo. T. Bouton, Clk. St. Comrs.

ERIE, PA.—The proposed intercepting sewer, for which bonds for $125,000 will soon be voted upon, will be awarded in four sections, the average cut of section 3 being 20 ft.

PHILADELPHIA, PA.—Bids are asked until Oct. 30 for main and branch sewers. James H. Windrim, Div. Pub. Wks.

ATLANTA, GA.—Ordinances have been presented for three sewers; estimated cost, $15,950.

JACKSONVILLE, FLA.—At an election Oct. 17, the citizens voted, 717 to 211, in favor of issuing $175,000 of bonds for sewerage and drainage.

MERIDIAN, MISS.—An election will be held Nov. 14 to vote on an issue of bonds for the proposed system.

CHICAGO, ILL.—The council has voted to construct sewers in 15 streets in Ward 13.

KEITHSBURG, ILL.—Harry P. Humbert, Cy. Clk., informs us that no sewers will probably be constructed until next spring.

MONTICELLO, ILL.—A complete system will be put in, according to reports.

PONTIAC, ILL.—The city clerk writes us that the city and state reformatory will construct about 3,500 ft. 12-in. pipe sewer, average cut 7 ft., estimated cost $7,000.

OMAHA, NEB.—The city has sold the second $50,000 of sewer bonds, recently issued.

KIRKWOOD, MO.—A committee has been appointed to secure plans for a system.

NEVADA, MO.—The city clerk will receive bids for 3,000 to 4,000 ft. of sewer extension.

ST. LOUIS, MO.—The board of public improvements will receive bids until Nov. 3 for six contracts.

HAYWARDS, CAL.—The town is condemning property to secure the necessary right of way for the sewer to the bay, for which $33,000 was recently voted.

SAN FRANCISCO, CAL.—Chas. H. Holcomb, Dep. Cy. Engr., has prepared plans for an outlet sewer in the Richmond district; estimated cost, $75,000.

STRATFORD, ONT.—A committee has been appointed to investigate the question of a system, sewage disposal works, etc.

STREETS.

BOSTON, MASS.—Bids are asked until Oct. 30 for about 65,000 cu. yds. of filling on Commonwealth Ave. H. H. Carter, Supt. Sts.

BUFFALO, N. Y.—For paving Baily Ave., Gorham St. and Benzinger St. with asphalt, the Barber Asphalt Paving Co. bid $181,809, $6,692 and $47,841, respectively, and the German Rock Asphalt Paving Co., $184,034, $6,734 and $47,314.

NEW YORK, N. Y.—Bids are asked until Nov. 3 for five contracts for grading, paving, etc. L. F. Haffen, Comr. St. Impvts., Wards 23 and 24.

GREENSBURG, PA.—During the past summer six streets have been paved at a total cost of $24,140, the prices being 20 cts. per cu. yd. for grading, 50 cts. per lin. ft. for curbing and $1.43 per sq. yd. for paving with brick, except in Oakland Ave. where the prices were 25 cts., 50 cts. and $1.32, respectively. Cyrus T. Long, Cy. Engr.

NEW CASTLE, PA.—The council has voted to receive new bids for paving Jefferson St. with asphalt blocks. The lowest bid received Oct. 14 is given under Contract Prices.

JACKSONVILLE, FLA.—The citizens have voted to issue $1,000,000 of bonds, as follows: Redeeming outstanding bonds, $200,000; water-works extensions, $223,000; sewers, $175,000; streets and parks, $175,000; city buildings, $100,000; electric lights, $75,000; bulkheading, $25,000; fire department, $25,000.

CINCINNATI, O.—The board of administration will receive bids until Nov. 15 for paving Bates Ave. with brick.

NORWOOD, O.—The contract for improving Harris Ave. has been awarded to Murdock & Co., at $23,000.

WEST CARROLLTON, O.—Bids are asked until Nov. 13 for $12,000 of bonds, of which $9,400 are street improvement bonds. Chas. Christman, Vil. Clk.

ZANESVILLE, O.—W. M. Shenneck, Jr., Cy. Clk., writes us that no more contracts for paving or sewers will be awarded this year.

INDIANAPOLIS, IND.—The board of works has taken final action for paving two alleys with brick.

CHICAGO, ILL.—The corporation counsel has notified the corporations that have torn up the pavements that all injured pavements must be relaid at once. About $600,000 worth of work is to be done by the corporations and it will be commenced at once.

EAST ST. LOUIS, ILL.—Hill & McCabe, St. Louis, have been awarded the contract for paving Pennsylvania Ave. with brick, at $27,189, and that for macadamizing Sixth St., at $8,884.

HARLEM, ILL.—The Seckner Contracting Co., Chicago, has been awarded a contract for macadamizing streets in this place.

WEST DULUTH, MINN.—Plans have been accepted for extending Grand Ave. through Ironton; estimated cost, $36,092.

KANSAS CITY, MO.—Ordinances have been passed for paving estimated to cost nearly $100,000.

ST. LOUIS, MO.—The board of public improvements will receive bids until Nov. 3 for 13 contracts for grading, macadamizing, etc.

TORONTO, ONT.—Contracts for paving two streets have been awarded to the Warren-Scharf Asphalt Paving Co., at $22,652.

ELECTRIC LIGHT AND POWER.

ALTOONA, PA.—A committee, including Councilmen Hawk, Shellenberger and Ward, has been appointed to investigate the advisability of a municipal electric light plant.

ATLANTA, GA.—The council is considering the question of a municipal plant. It is estimated that 1,000 arc lights of 2,000 c. p. would light the city, including West End, and cost $60 per light, while the city is now paying $100 per year for arc lights. The electric light company, on the other hand, is reported as claiming that the average price paid by over 200 cities is $156.48 per arc light.

JACKSONVILLE, FLA.—The city has voted to issue bonds for $75,000 for an electric light plant.

KALAMAZOO, MICH.—The following bids have been received for lighting the city: Kalamazoo Electric Co., three-year contract, 33 cts. per night per light for midnight lights, and 50 cts. for all night; ten-year contract, 27½ cts. and 45 cts.; T. F. Connell, Chicago, midnight 29 cts., all night 46 cts.; P. Nicoby, Chicago, midnight $9 per month per lamp, and $14 for all night; Thomas O'Donnell, Chicago, 5 cts. per hour per lamp.

MONROE, MICH.—It is reported three electric railway companies have petitioned for franchises, and that the council wishes the successful company to put in an electric light plant and help light the city, as well as to give competition to the present company.

COAL CITY, ILL.—Bids are asked for an electric light plant. W. G. Suffern, Vil. Clk.

EMPORIA, KAN.—Steps are being taken to purchase a municipal plant.

CAPE GIRARDEAU, MO.—Bids are asked until Dec. 4 for 20 arc lights for 10 years. G. E. Chappell, Cy. Clk.

WELLAND, ONT.—Application will be made to the next Parliament to incorporate the Welland Power & Supply Canal Co., to construct a canal from the Welland River, in the township of Stamford, to develop power for the generating of electricity.

NEW COMPANIES.—Overbrook Electric Co., Philadelphia, Pa.; $10,000; Treas., Walter B. Smith.——People's Power Co., Rock Island, Ill.; $30,000; Thos. B. Davis, S. Davis, Chas. I. Nason.——Des Moines Rapids Power Co., Hamilton, Ill.; $500,000; Lewis W. Carr, Jas. Anthony, C. B. Holmes.——Carpenter Electric Power & Light Co., East St. Louis, Ill.; $2,000,000; Hiram H. Carpenter, E. C. Dawes, James C. Brush.——Jamaica Electric Light Co., Jamaica, N. Y.; $15,000.——Jonesville Electric Light & Power Co., Jonesville, Mich.; $15,000.

CONTRACT PRICES.

ASPHALT BLOCK PAVING.—New Castle, Pa.—The lowest bid for paving Jefferson St. with asphalt blocks was as follows: H. C. Howard, grading, 59 cts. per cu. yd.; curbing, 53 cts. per lin. ft.; curbing reset and dressed, 35 cts.; paving, $2.65, $2.42 and $2.27 per sq. yd., respectively, for foundations of 6 ins. concrete, crushed furnace slag and gravel, and 9 ins. gravel with a good layer of sand. All bids were rejected as too high.

HOSE.—St. Paul, Minn.—The fire commissioners have awarded a contract for 1,000 ft. of hose to each of the following bidders: Watrous Engine Works, St. Paul, 90 cts. per ft.; Jilson & Satterlee, representing the Gutta Percha Rubber Co., Chicago, 90 cts.; M. J. O'Brien, representing the Mineralized Rubber Co., New York, 76 cts. The last bid was accepted on condition that if the hose gives satisfaction for a year it will be paid for.

DRAINAGE CANAL.—Chicago, Ill.—We published in our issue of Oct. 12 a statement of the bids received for the reletting of sections 2, 3 and 4 of the drainage canal. No awards have yet been made, and McArthur Bros., the original contractors for this work, are reported to have since submitted the following new bid: Section 2, glacial drift, 50 cts. per cu. yd.; rock, 80 cts; retaining walls, $1.74; Sec. 3, 56 cts., 76 cts., $1.75, respectively; Sec. 4, 49 cts., 80 cts., $1.87. The lowest bids, as stated Oct. 12, were as follows: Sec. 2, 48 cts., 84 cts., $1.80; Sec. 3, 48 cts., 84 cts., $1.80; Sec. 4, 46 cts., 84 cts., $2.26.

LEVEE WORK.—New Orleans, La.—Capt. Jno. Millis, U. S. Engineer Office, has received the following additional lowest bids; Donovan, Daly & Co., College Point, Ponchartrain district: 85,000 cu. yds. levee and 300 cu. yds. base ditch, 10.4 cts. and 10 cts. per cu. yd., respectively; Eltringham Construction Co., Reserve, 15,000 cu. yds. and 100 cu. yds., 12.23 cts. and 10 cts.; R. McNamara, Myrtle Grove, Lafourche district, 8,000 cu. yds. and 400 cu. yds., 16 cts. and 12 cts.; F. L. Carson & Co., Simmesport, enlargement, Atchafalaya district, 6,000 cu. yds., 14.49 cts.——The contract for the construction of the new Cofield levee, Ascension parish, 40,000 cu. yds., has been awarded to A. Ettingham Construction Co., at 12.2 cts. per cu. yd.

SEWERS.—Covington, Ky.—The contracts for the Willow Run sewer have been awarded to the lowest bidders as follows: Section 1, Patterson & Shipman, Cincinnati, 12-ft. brick sewer, 150 lin. ft., $13.25 per lin. ft.; 11-ft., 1,450 lin. ft., $13; 6-ft., $6.50; 5-ft, 50 lin. ft., $5.50; 3-ft., 150 lin. ft., $3.50; 24-in. pipe sewer, $2; 21-in., 260 lin. ft., $1.25; 18-in., 120 lin. ft., 98 cts.; 15-in., 90 cts.; 12-in., 80 cts.; 6-in. slants, 43, 50 cts. each; manholes, 6, $25; excavation, 22 cts. per cu. yd.; refilling, extra material, 22 cts.; rubble masonry, 2,800 cu. yds., $4.10; concrete, 1,700 cu. yds., $4; timber foundation, 19,900 ft. B. M., $24 per M ft.; total, $43,319.——Section 2, Myers Bros., Covington, 10-ft. brick sewer, 1,800 lin. ft., $9.75; 9-ft., 425 lin. ft., $9; 6-ft., 210 lin. ft., $5.60; 5-ft., $4; 3-ft., 200 lin. ft., $2.80; 24-in. pipe sewer, $1.55; 21-in., 200 lin. ft., 95 cts.; 18-in., 200 lin. ft., 70 cts.; 15-in., 55 cts.; 12-in., 40 cts.; 6-in. slants, 74, 55 cts. each; manholes, 10, $16; excavation, 30 cts. per cu. yd.; refilling, extra material, 60 cts.; rubble masonry, 2,940 cu. yds., $3.60; concrete, 1,900 cu. yds., $4.10; timber foundation, 10,000 ft. B. M., $28 per M ft.; total, $46,074. Thos. H. Kennedy, Cy. Engr.

Des Moines, Ia.—The following bids have been received for a 12-in. sewer in Oak St.: M. Morkin, 94½ cts. per lin. ft.; P. Griffin, 94 cts.; John Hurley, $1.69; McCauley & Fleming, $1.38; E. D. Janes, $1.19⅓; T. M. Kavanaugh, $1.31; O'Brien & Carey, $1.10.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

FIRE HOSE.—Cleveland, O.—Bids are asked until Nov. 1 for 5,000 ft. 2½-in. and 1,000 ft. 3½-in. rubber lined cotton hose. H. H. Hyman, Dir. fire service.

BONDS.—Toledo, O.—Bids are asked until Nov. 15 for $500,000 of 50-year 4% bonds to be issued by the court house commissioner. Chas. H. Jones, Co. Aud.

FERRY IMPROVEMENTS.— Ottawa, Ont.—Bids are asked until Nov. 14 for the improvement of the ferry landing at Campbellton, N. B. E. F. E. Roy, Secy. Dep. Pub. Wks.

COURT HOUSE.—San Bernardino, Cal.—Bids are asked until Dec. 20 for an addition and extension to the county court house. C. H. Jones, architect; T. J. Bolton, Clk. Bd.

PIERS.—New York, N .Y.—The dock commissioners have voted to construct a new pier at West 54th St., 650 ft. long and 50 ft. wide, and one at East 96th St., 200 ft. long and 65 ft. wide.

BOILER SHOP.—Washington, D. C.—Bids will be received at the bureau of yards and docks until Nov. 18 for reconstructing boiler shop at Portsmouth navy yard. N. H. Farquhar, Ch. Bureau.

BUILDING PLANS.—Houston, Tex.—Plans and specifications are asked until Dec. 1 for a $75,000 high school building, $1,500 to be paid for the accepted plans. W. S. Sutton, Supt. Schools; J. T. Browne, Mayor.

DRAINAGE PUMPS.—New Orleans, La.—The city engineer has recommended that the contract for centrifugal pumps at the Bienville and Melpomene drainage stations be awarded to the Edward P. Allis Co., Milwaukee, at $92,000.

LEVEE WORK.—New Orlans, La.—The Pontchartrain levee board will receive bids until Nov. 10 for 1,000,000 cu. yds. of earthwork, of which 600,000 cu. yds. are to be done before April 15 next.——Bids will be received at the U. S. Engineer Office until Nov. 6, 7, 8 and 9 for levee work. Capt. John Millis, U. S. A.

SPILLWAY.—Chicago, Ill.—The drainage board has prepared plans for a 400-ft. spillway 200 ft. above the Santa Fe railway bridge at Summit. This would relieve the city from all danger from the Desplaines River flood waters except in case of extraordinary flood, and the chief engineer has recommended that work be done by day labor under the board's engineers.

GAS.—Detroit, Mich.—The Detroit Gas Co. has agreed upon a compromise whereby the price of gas is to be reduced from $1.50 to $1 per cu. ft. for illuminating gas and 80 cts. for artificial fuel gas. When the annual consumption shall have reached 600 or 800 million cu. ft. the price for illuminating gas is to be 90 cts. or 80 cts., respectively. The company is to be granted a 30-year franchise, at the end of which time the city may purchase the plant; present litigation to be discontinued.

PARK WORK.—Boston, Mass.—The park department has opened the following bids: Surfacing roads between Tremont and Perkins Sts., H. P. Nawn, $34,800; Doherty & O'Leary, $22,800; Jas. Killian, $34,000; P. F. Maney & Co., $28,000; David Hall, $28,400; Neil McBride, $37,400; Molten & O'Mahoney, $19,000. Bridle path stone bridge: W. L. Miller, $44,445; W. S. Sampson, $44,921; Jones & Meehan, $34,600; Johnson Bros., $32,300. Field house at Wood Island Park: Jos. Ross, $17,435 with the roof, or $16,294 with slate roof; J. Robbins & Co., $19,061 or $18,261; Edward Lynch, $17,267 or $15,392; Frame & McPherson, $18,976 or $16,297; Charles H. Dodge, $16,605 or $15,805; Daniel M. O'Connel, $21,200 or $20,800.

CANALS.—Atlanta, Ga.—It is stated that the Alabama & Georgia Canal & Transportation Co. has been chartered in New York with a capital stock of $5,000,000 to construct about 150 miles of canal in the section between this city, Brunswick and Montgomery, Ala. A canal would commence on the Tennessee River about 27 miles east of Decatur, Ala., and extend to Birmingham and down the Coosa River to Montgomery and Selma and thence to Mobile and Dauphin Island. A second branch would extend from Montgomery to Columbus, reaching this city, Hawkinsville, Lumber City, Savannah and Brunswick. Steel boats, drawing 8 ft. of water and using electric propelling power would be used. The canals are expected to cost about $5,000 per mile. Capt. W. W. Goodrich has been appointed the company's architect with headquarters in this city.

INDUSTRIAL NOTES.

THE BROOKS LOCOMOTIVE WORKS, Dunkirk, N. Y., have built 15 engines for the Illinois Central, one of which is for anthracite fuel.

THE RHODE ISLAND LOCOMOTIVE WORKS, Providence, R. I., have delivered eight Forney tank engines to the New York elevated railway.

THE MOUNT VERNON CAR MFG. CO., Mount Vernon, Ill., has an order of 250 coal cars of 60,000 lbs. capacity for the Louisville, Evansville & Terre Haute.

THE SOUTH BALTIMORE CAR WORKS, Baltimore, Md., have gone into the hands of a receiver, but the shops will be kept in operation, as large contracts are on hand.

CAR LIGHTING.—The Safety Car Lighting & Heating Co., New York, N. Y., will build a Pintsch compressed gas plant at Portland, Me., to supply cars on the Maine Central and Boston & Maine.

VALVES.—The Chapman Valve Co., of Indian Orchard, Mass., is completing a 60 × 260-ft. addition to their plant, which will be used for the manufacture of large sizes of water and steam valves. The company furnishes many large valves for street railway plants.

THE STOW MFG. CO., of Binghamton, N. Y., manufacturing the Stow flexible shaft, reports that its trade for 1893, up to Oct. 1, shows an increase over that of the corresponding months of 1892. Considering the general depression, this should be decidedly satisfactory. During the past two months the company has greatly improved its plant, adding largely to the boiler capacity, etc., thus demonstrating its confidence in the future.

NEW COMPANIES.—Smith Emergency Brake Mfg. Co., Emporia, Kan.; $250,000; C. S. Cross, J. D. Holden and Otis D. Swan. Smokeless Combustion Co., Chicago, Ill.; pulverized fuel; $2,000,000; William Cuthbert and G. P. Beacham. Standard Valve Co., Chicago, Ill.; $60,000; C. G. Singer, B. F. Teal and F. S. Comstock. Drexel Railway Supply Mfg. Co., Chicago, Ill.; $150,000; W. A. Alexander and D. W. McCord.